Power

A McGRAW-HILL PUBLICATION

Plant Design Issue

Practical ways to meet today's biggest challenge...

OCTOBER 1958 TWO DOLLARS

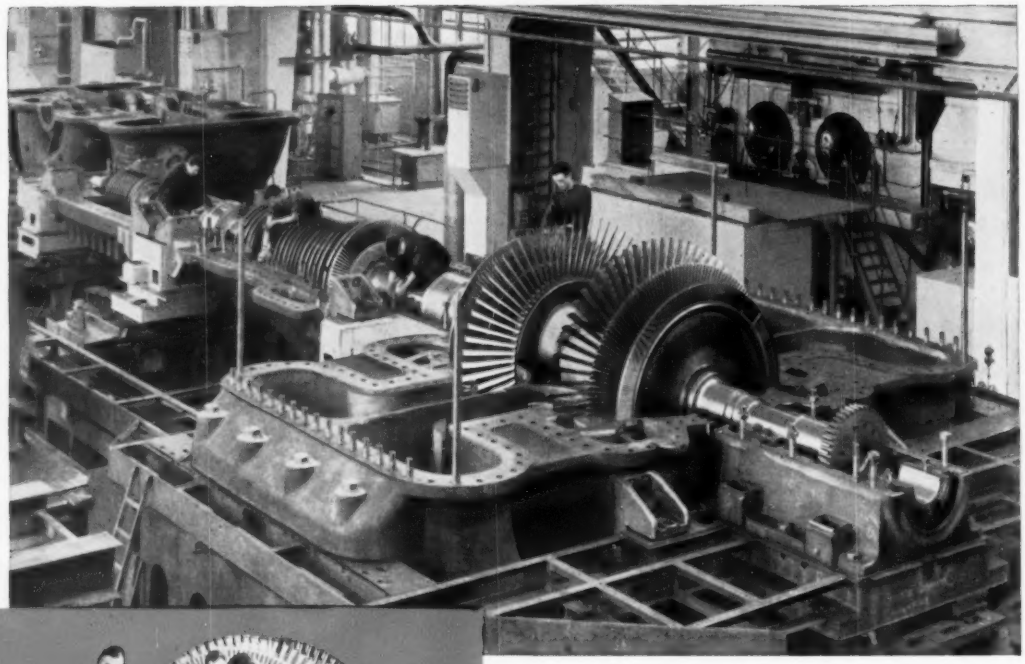
PLAN '59

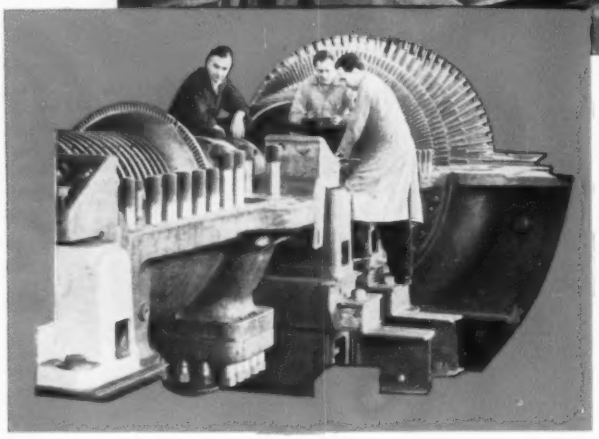
Modernize now for growth and profits

A SPECIAL REPORT FROM McGRAW-HILL TO AMERICA'S BUSINESS EXECUTIVES

McGraw-Hill's 34 business publications join in a major editorial effort to show why and how American industry must modernize now. This is PLAN '59

As its part in this program, POWER presents this handbook issue packed with pace-setting plant-layout ideas and the equipment to put them to work





New AEG Turbine Test Bay

In one of the largest and most up-to-date test bays in Europe AEG turbines now undergo exacting performance tests under actual service conditions prior to leaving the factory. Test and research work can proceed on several turbines simultaneously.

A high-pressure high-temperature boiler rated for 2350 psig (165 atg) and 1200° F (650° C) supplies the steam requirements.

This new testing installation is but another convincing proof of AEG's constant endeavour to offer their customers nothing but the best.

AEG

8390e

ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT

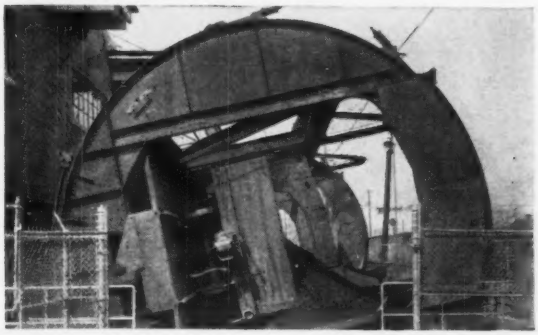
Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)

For more facts circle 776 on Reader Service Card p 222

LINK-BELT equipment

leads the way to lowest cost-per-ton coal handling

UNLOADING

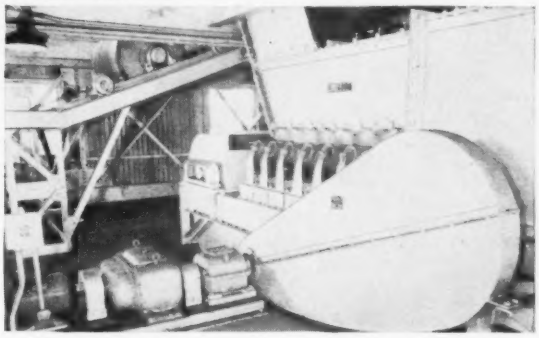


ROTARY DUMPERS provide rapid, economical unloading of all types of open-top cars up to ninety-ton capacity. They empty the load thoroughly, even if coal is moist, fine or frozen.

RECLAIMING

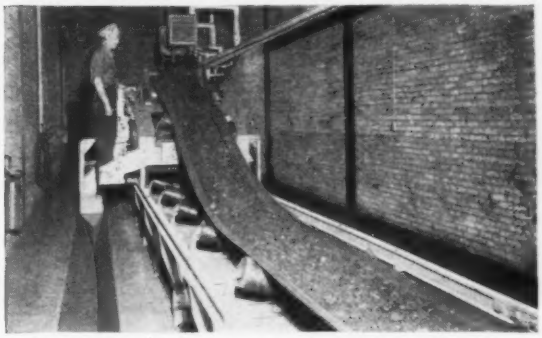
HIGH-CAPACITY RECLAIMING is obtained with independent system of hoppers, feeders and conveyors which assure fast, efficient, economical transfer of coal from storage to bunkers.

FEEDING



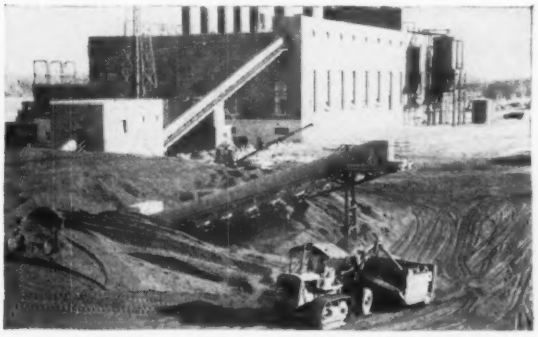
FEEDERS move coal from receiving hopper. Line includes belt (above), apron, screw, vibrating and other types. Link-Belt also makes a complete line of mechanical power transmission products.

DISTRIBUTING



BELT CONVEYORS transport large tonnages quickly and at low cost . . . stock out, reclaim, distribute. When distributing coal to bunkers, plow on tripper and bin seal, confine dust.

STORING



STORAGE SYSTEMS for any capacity can be designed, equipped and installed by Link-Belt. At small power plants, Link-Belt elevators, silos and conveyors for reclaiming provide low-cost storage.

IN public utility power plants . . . in commercial, industrial and institutional boiler houses — wherever power, heat or steam for processing is produced by coal, Link-Belt can recommend the right methods and equipment to achieve lowest per-ton handling costs.

Find out how this *one-source* service can improve *your* coal handling procedures. Link-Belt will work with your engineers and consultants from planning through erection of your system . . . or can assume complete responsibility for the entire installation. Contact your nearest Link-Belt office for complete information. Ask for Book 2410.

LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 14,880

For more facts circle 779 on Reader Service Card p 222

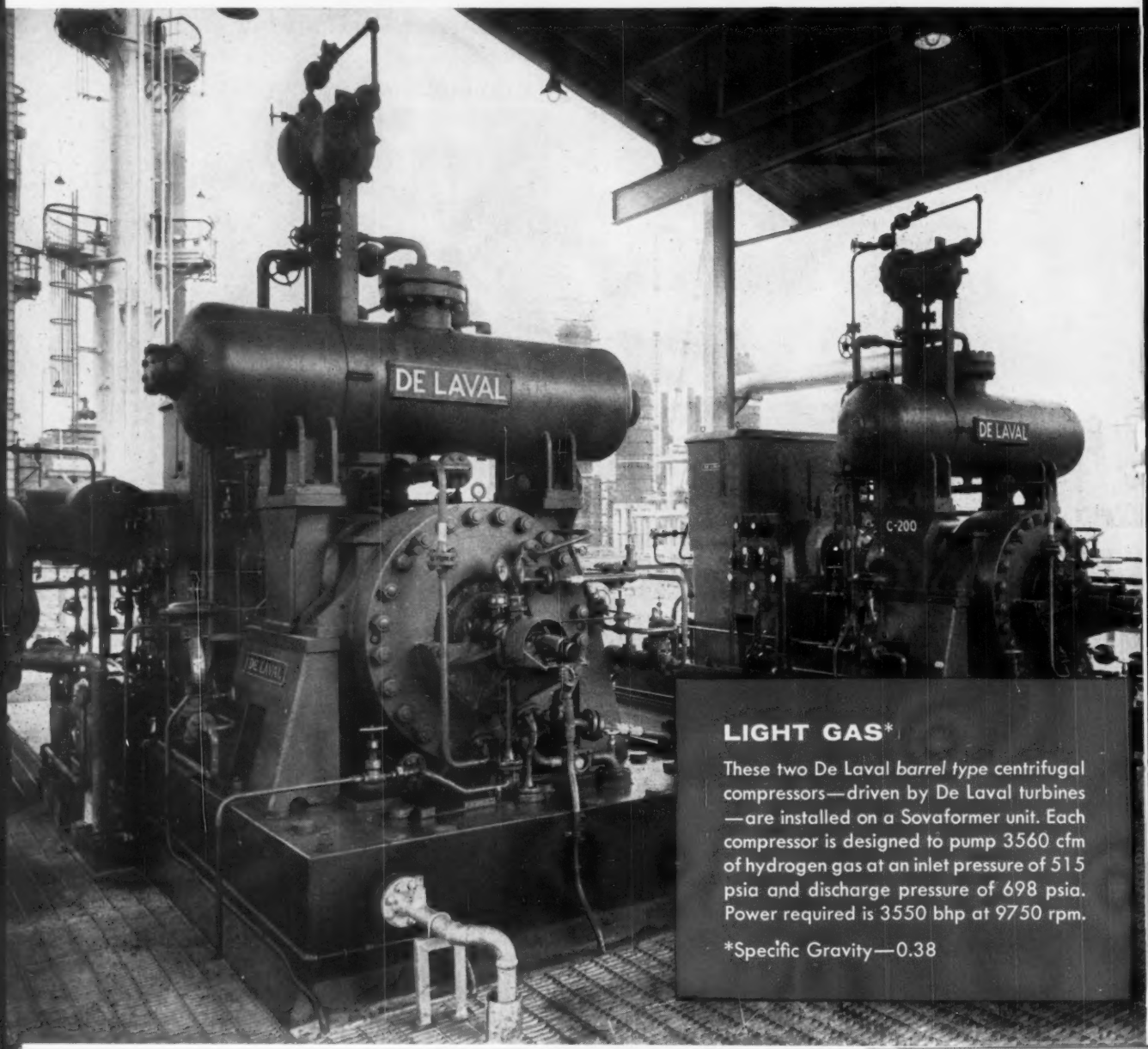
DE LAVAL CENTRIFUGAL COMPRESSORS used for light gas, in Magnolia

As part of the expansion program in the Beaumont, Texas refinery of the Magnolia Petroleum Company, De Laval turbine-driven centrifugal compressors are on stream in three important applications:

- **recirculating hydrogen gas in a reforming unit**
- **pumping hydrocarbon gas in a compressor station**
- **supplying combustion air on a giant cat cracker**

Designed and built to perform dependably in heavy-duty continuous operation, De Laval centrifugal compressors are available for every refinery process. Whether you need to handle light or heavy gases at high or low pressures in catalytic cracking, reforming, alkylation, coking or any similar service, it pays to look to De Laval. We can give you the benefit of more than 40 years of experience in solving gas compression problems.

SEND FOR DE LAVAL BULLETIN 0504.



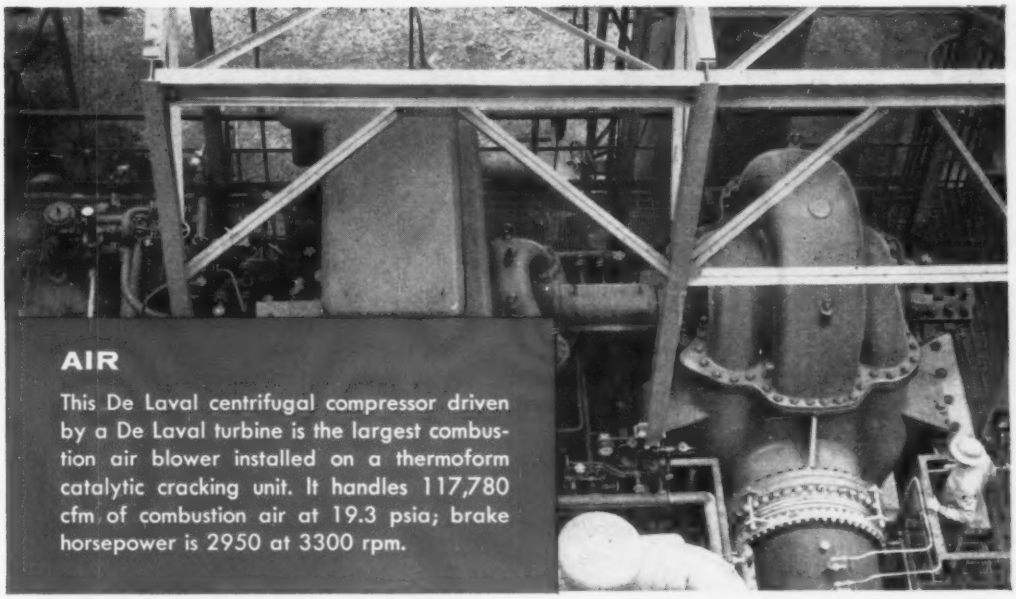
LIGHT GAS*

These two De Laval *barrel type* centrifugal compressors—driven by De Laval turbines—are installed on a Sovaformer unit. Each compressor is designed to pump 3560 cfm of hydrogen gas at an inlet pressure of 515 psia and discharge pressure of 698 psia. Power required is 3550 bhp at 9750 rpm.

*Specific Gravity—0.38

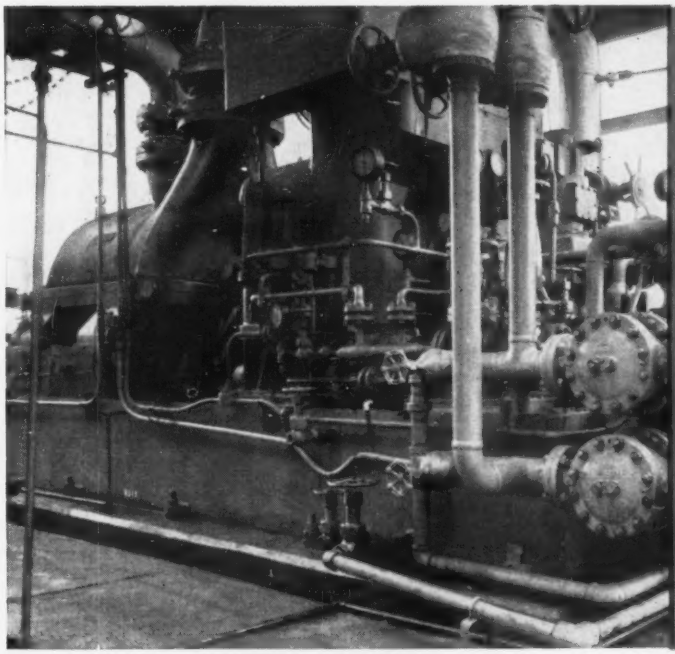
For more facts circle 779 on Reader Service Card p 222

heavy gas and air handling Petroleum's expansion program



AIR

This De Laval centrifugal compressor driven by a De Laval turbine is the largest combustion air blower installed on a thermoform catalytic cracking unit. It handles 117,780 cfm of combustion air at 19.3 psia; brake horsepower is 2950 at 3300 rpm.



HEAVY GAS*

This De Laval centrifugal compressor and turbine installation is located in Magnolia Petroleum's number 1 gas compressor station. The unit is designed to pump 10,560 cfm of hydrocarbon gas at 65.0 psia with a suction pressure of 14.0 psia.

* Specific Gravity—1.376

DE LAVAL *Centrifugal Compressors*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL-419

For more facts circle 780 on Reader Service Card p 222

Power Plant Design Issue

INDUSTRIAL PLANT DESIGN

Sound planning for coming growth is sharply reflected in these industrial power service installations. The survey, p 105, covers industrial power plants and packaged boilers plus first tabulation of industrial electrical-distribution practices

CENTRAL STATION DESIGN

These are the facts on how utilities are keeping up with the ever-growing demand for power. Report on specific pace-setting plants is followed by a station-by-station design survey

EQUIPMENT AND LITERATURE ROUNDUP

For the latest products,

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POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly by McGraw-Hill Publishing Company, Inc, James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W 42nd St, New York 36, N. Y. See box, right, for directions regarding subscriptions or change of address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W 42nd St, New York 36, N. Y. Donald C McGraw, President; Joseph A Gerardi, Executive Vice-President; L Keith Goodrich, Vice-President and Treasurer; John J Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B Smith, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising Sales; A R Venezian, Vice-President and Circulation Coordinator.

Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of the power and plant services in utilities, consulting and contracting firms, industrial and service plants. Position and company connection must be indicated on subscription orders. Send to address shown in box, right.

United States subscription rate for individuals in the field of the publication $5.00 per year, single copies $1.00, unless otherwise indicated. Canada; $7.00 for one year. Foreign; $15.00 for one year. Second-class

VOL. 102 • OCT 1958 • NO. 10 • TWO DOLLARS

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Power articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

SUBSCRIPTIONS: Send subscription correspondence and change of address to Fulfillment Manager, POWER, 330 W 42nd St, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, and including postal zone number, if any (Official Post Office request). If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

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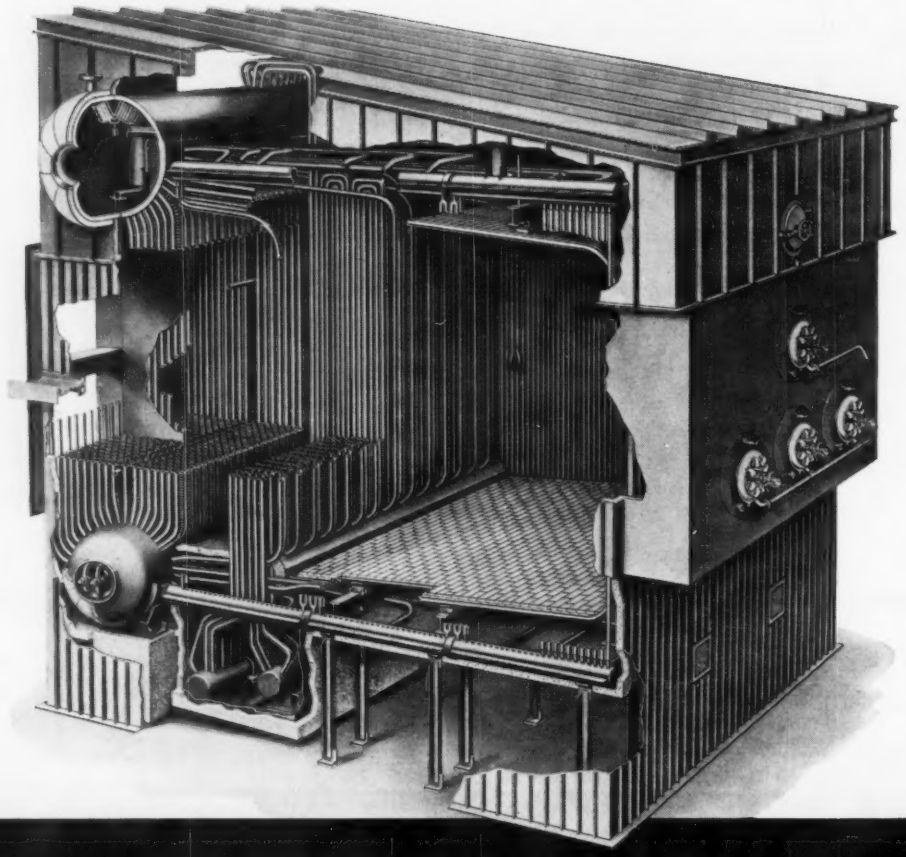
Designed For Tomorrow's New, Economical



HERE ARE 8 WAYS IN WHICH THE PFI BOILER CAN BE OF BENEFIT TO YOU:

1. It requires a minimum amount of space for a given power output.
2. The pressurized furnace design assures economy by eliminating the induced draft fan and air infiltration. This means savings in cost of fans, fuel, and operating power.
3. Pre-assembly of many of the components of the PFI Boiler is controlled in B&W shops, resulting in a reduction of the time and manpower required for field erection.
4. The PFI is designed to burn oil, gas, or a combination of the two. When it is equipped with a dual-fuel burner, it allows you to take advantage of favorable market conditions.
5. Cyclone Steam Separators ensure adequate water circulation which protects boiler tubes from overheating, even with wide and frequent changes in load. They also give you clean, dry steam at all designed ratings with high boiler water concentrations.
6. The drainable superheater design assures quick, safe start-up and ease of storage.
7. Water-Cooled Burner Throat eliminates troublesome maintenance, costly repairs.
8. All-welded Membrane Wall contributes to high efficiency and reduces insulation requirements.

Plants
Power For Industry

New B&W
PFI Oil-Gas Burning Unit Provides Maximum Output in Minimum Space

Here's an answer to industry's need for an economical, dependable steam supply. The new B&W Integral-Furnace Boiler produces high-quality, dependable steam economically at all ratings. Aptly named the PFI, the "Power for Industry" Boiler is compact, easy to install, quick to meet rapid and wide load swings. The new boiler gives long, sustained operation, requires little attention and is readily accessible for inspection, cleaning and maintenance.

All responsibility for your complete delivered and erected unit is accepted by one experienced, dependable source which in the past 25 years alone has placed over 4,000 Integral-Furnace Boilers in service. Behind *every* B&W Boiler is nearly a century of leadership in steam generation. A national network of B&W plants and engineering facilities means that the special skills of B&W engineers are always quickly available to you for service and assistance. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

For further information about the B&W PFI Boiler, write for Bulletin G-94.

BABCOCK & WILCOX

B&W

BOILER DIVISION

G-899

For more facts circle 781 on Reader Service Card p 222

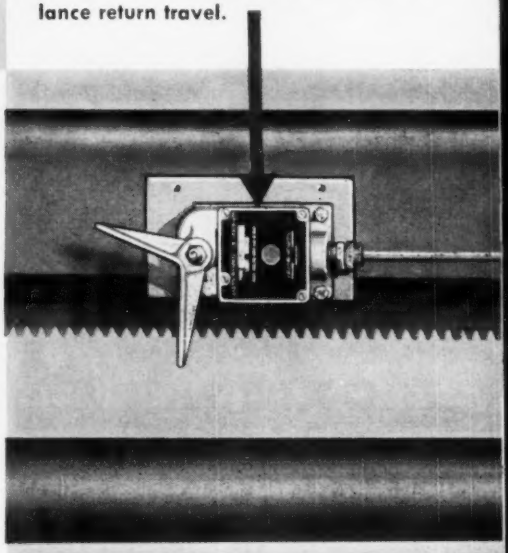
ELECTRIC POWER and CONTROL TERMINAL FACILITIES

ANOTHER

Simple, convenient, rugged . . . the electric power and control center of the new Series 300 IK contributes substantially to the dependable, trouble-free operation of this blower. Terminal facilities and the control assembly are concentrated in a cast aluminum box at the drive end. No internal field wiring is required; the blower is completely wired at the factory. The control is linked directly to lance travel and is governed by two durable snap switches . . . actuated by a cam on the lance carriage.

Additional important features of the new Series 300 IK are listed in the panel below. Check them and you will understand why this blower is establishing a new standard of efficiency, economy and dependability in cleaning those heating surfaces that require a long retracting blower. For further information about the new Series 300 IK, ask the nearest Diamond office or write directly to Lancaster for Bulletin 2111U.

Inboard Travel Limit Switch (cover removed). Switch near other end limits lance return travel.



Control for air operation is also simple, compact, accessible and dependable.

Other Advantages of Series 300 IK Blowers

- Backbone and Protective Cover
- Front End Single-Motor Drive
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other Blower gives you ALL THESE ADVANTAGES

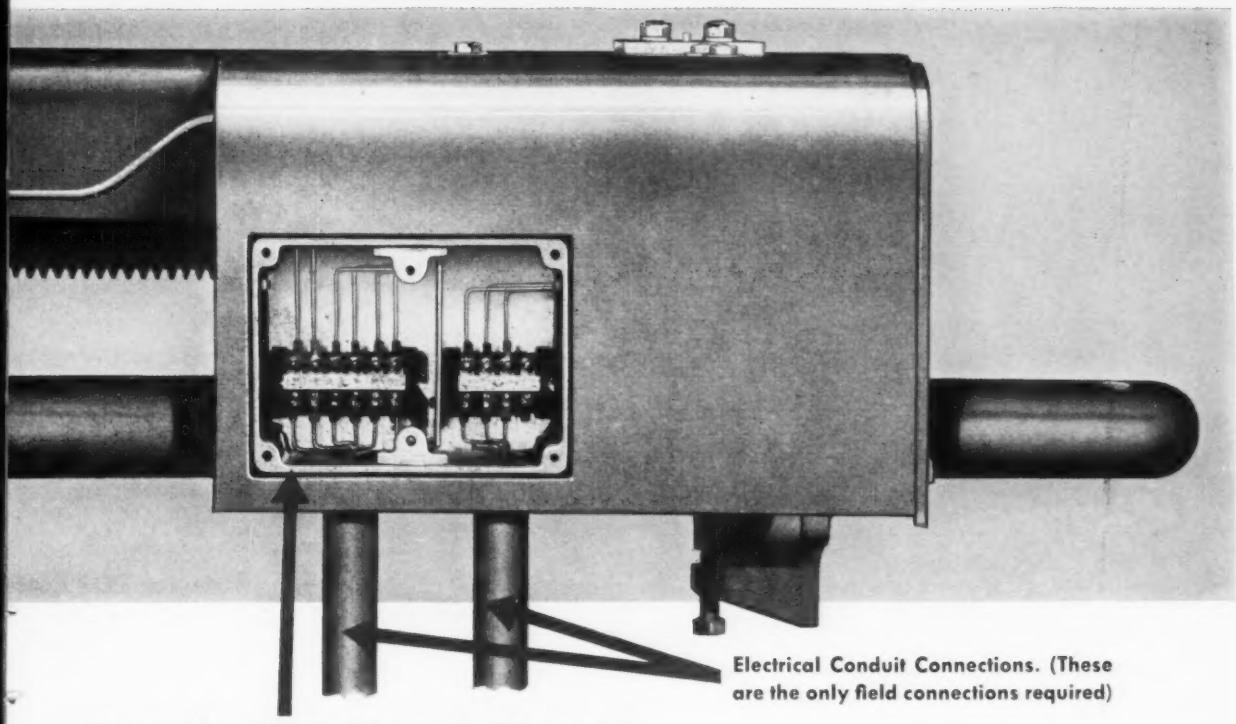
Diamond

DIAMOND POWER

IMPORTANT FEATURE

of the new Diamond series 300 IK

LONG RETRACTING BLOWER



Electrical Conduit Connections. (These are the only field connections required)

Motor and Control Electrical Terminal Facilities centered in weather-resistant enclosure at drive end for improved accessibility and protection. (cover removed)

New Series 300 IK Long Retracting Blower.

"You Clean Boilers Better and at lower Cost with Diamond Blowers"

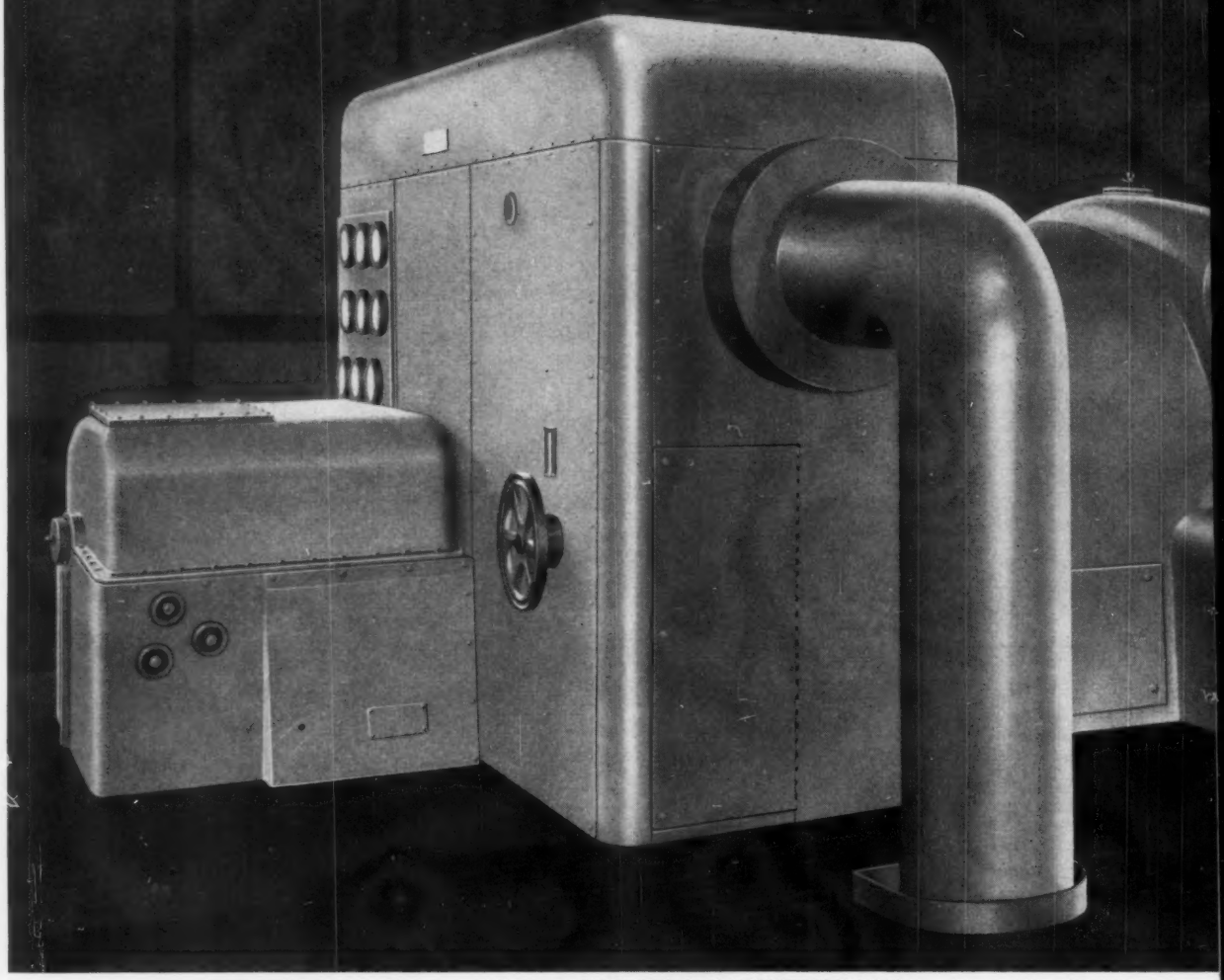
7703

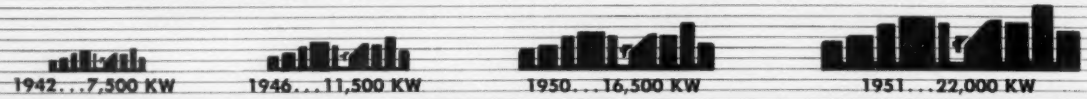
SPECIALTY CORP. **LANCASTER, OHIO**

Diamond Specialty Limited • Windsor, Ontario

For more facts circle 782 on Reader Service Card p 222

A solid background of TURBINE-GENERATOR





Year after year . . . Elliott turbine-generators are

EXPERIENCE

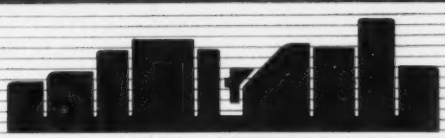
The excellent operation of this 16,500-kw hydrogen-cooled turbine-generator unit is the result of Elliott Company's background of 50 years experience in designing, and building turbine-generator units. The steady march in size ratings is accomplished by a step-by-step introduction of proven components added to each larger size.

Elliott is currently building a 33,000-kw unit and has the facilities, experienced engineers, and craftsmen, to produce size ratings to 44,000 kw. For complete engineering data, call your nearby Elliott district office or write Elliott Company, Steam Turbine Department, Jeannette, Pa.

ELLIOTT Company

HS-4

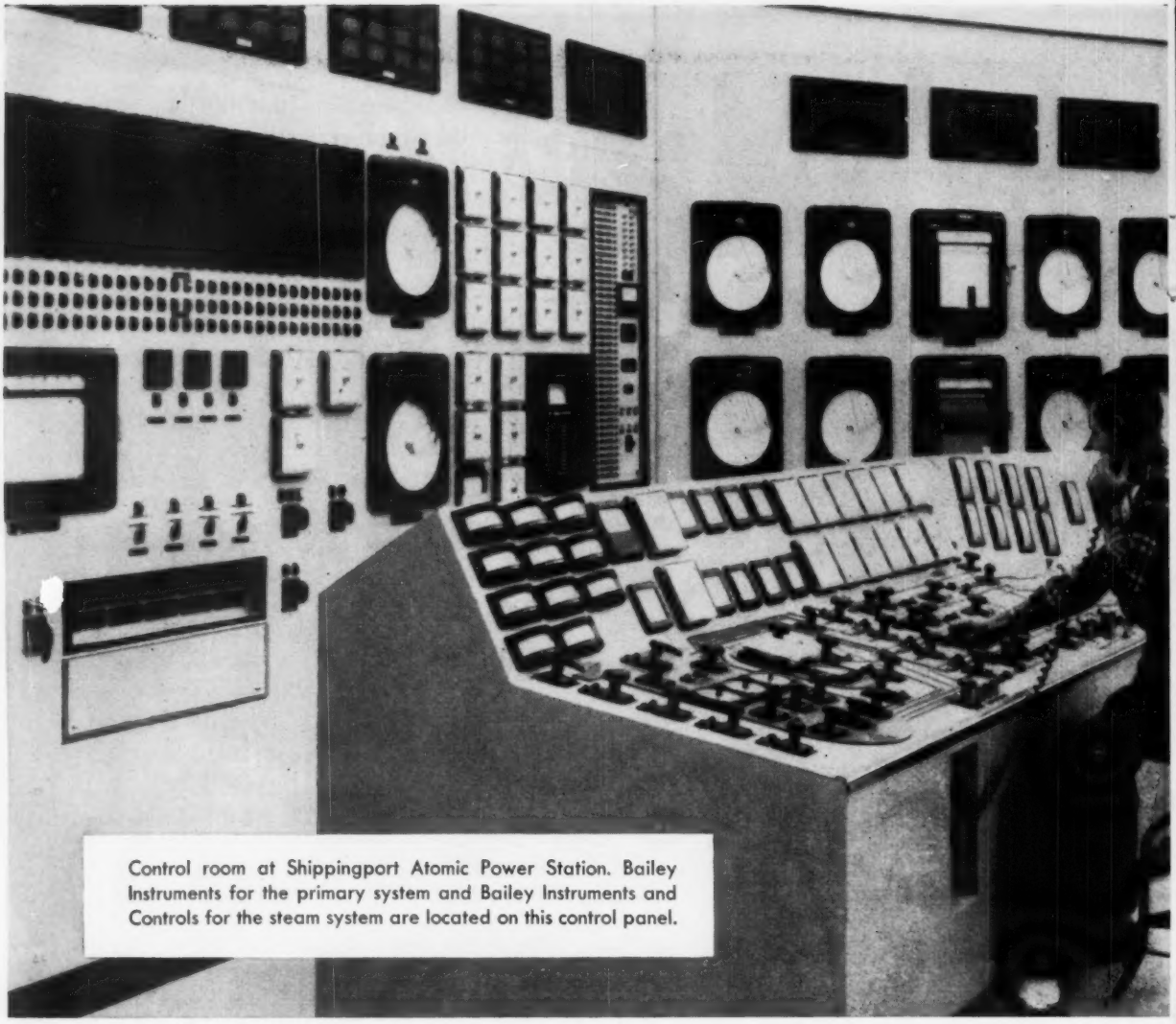
In this turbine-generator aisle, Elliott has the large machine tool equipment and handling facilities for manufacturing. Under construction is a 33,000-kw unit—designed and built to meet the exact requirements of the user.



1957 . . . 33,000 KW

getting Bigger and Bigger

For more facts circle 783 on Reader Service Card p 222



Control room at Shippingport Atomic Power Station. Bailey Instruments for the primary system and Bailey Instruments and Controls for the steam system are located on this control panel.

Bailey pioneers the control of . . .

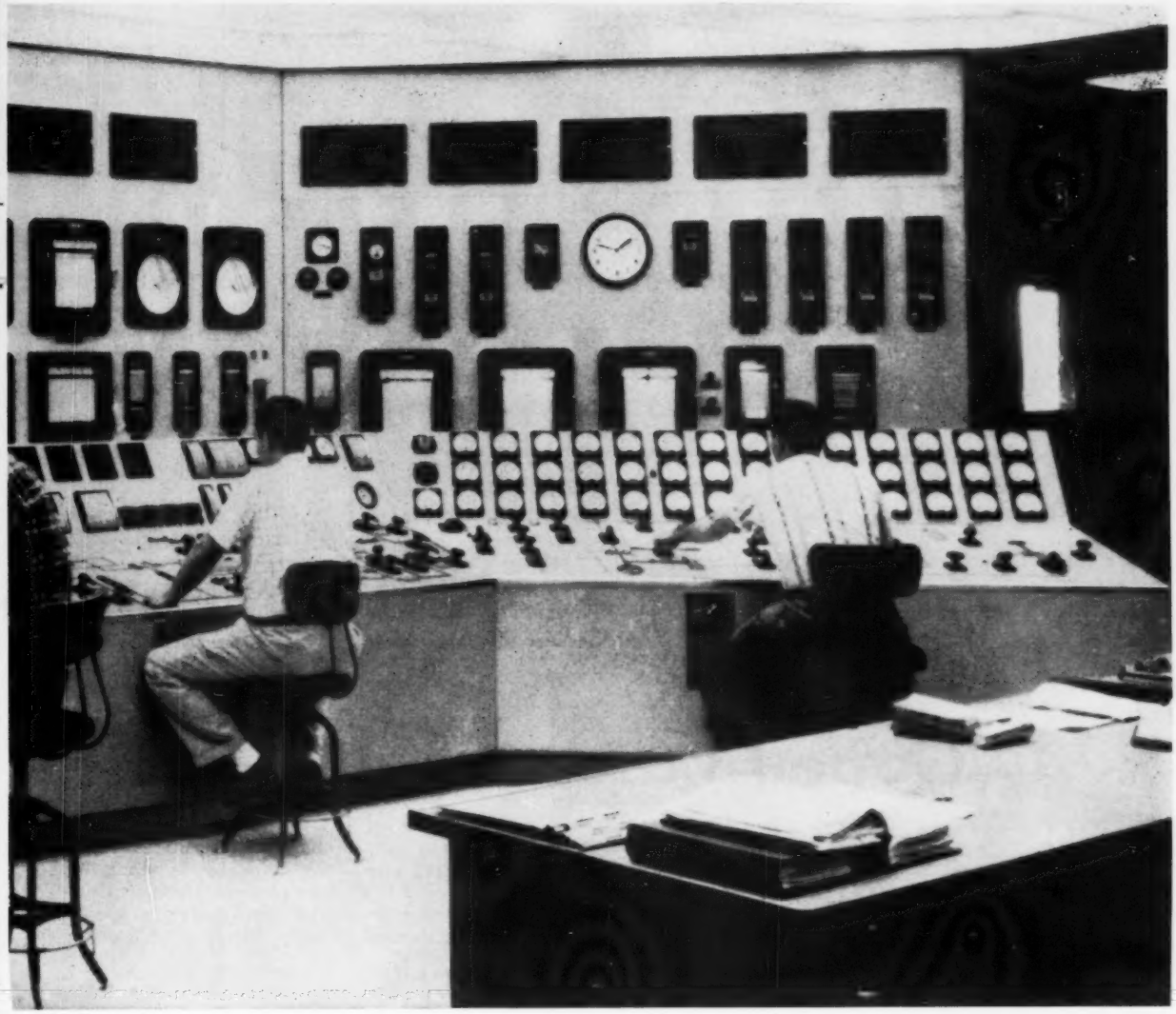
This control room is the center of operations for the world's first full-scale atomic, electric power plant devoted exclusively to civilian use—the Shippingport Station, jointly owned by Duquesne Light Company and the Atomic Energy Commission.

Here, as well as on the atomic-powered submarines, are Bailey Instruments and Controls performing dependably hour after hour, month after month.

In conventional power plants, too, Bailey Meters and Controls are standard equipment. Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion and automatic control are your assurance of the best possible system.



ATOMIC STEAM POWER PLANTS

2. Experience

Bailey engineers have been making steam plants work efficiently for more than forty years. Veteran engineer and young engineer alike, the men who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A136-2

Instruments and controls for power and process

BAILEY METER COMPANY

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BAILEY METERS

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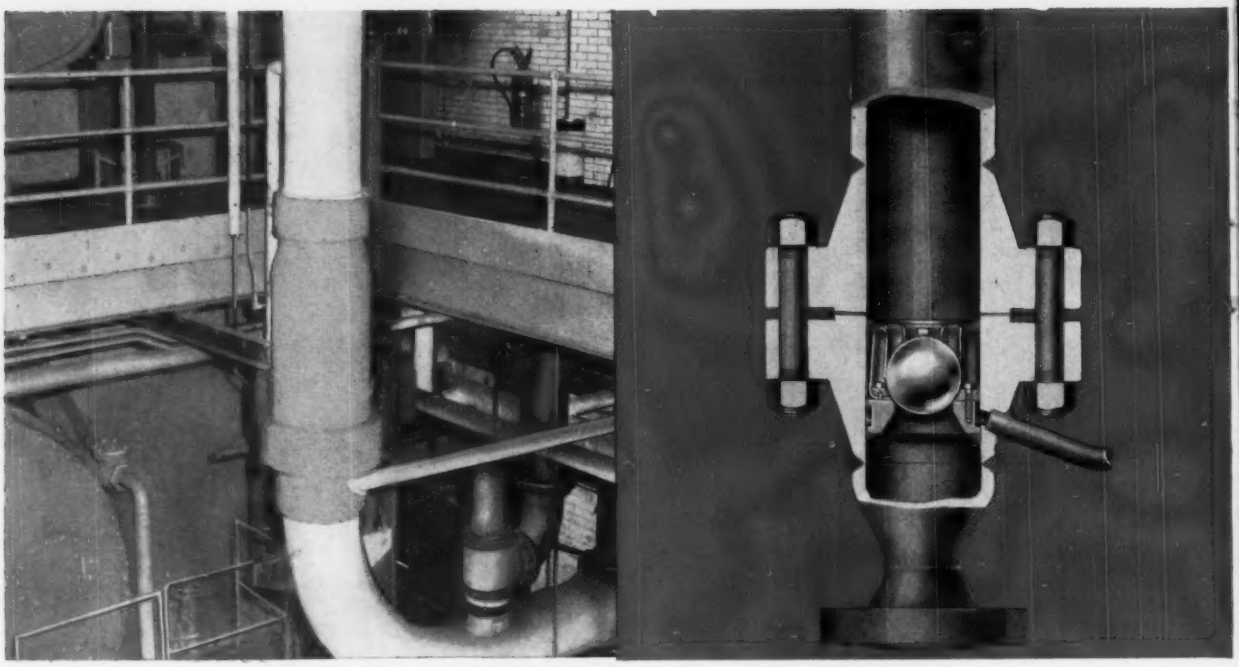


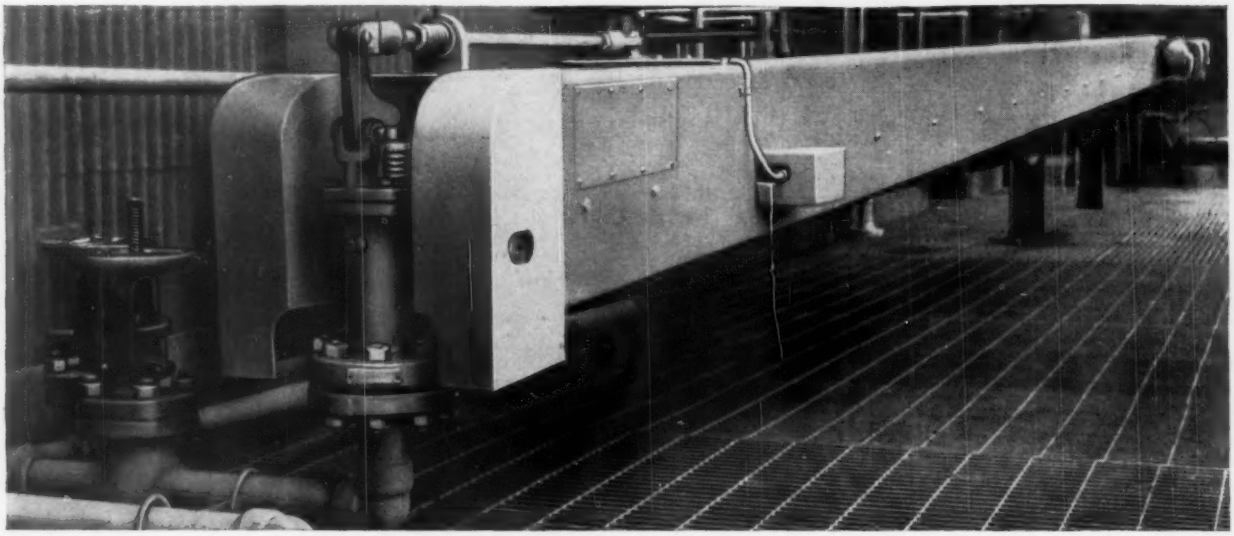
New Variable-Orifice Desuperheater holds reduced steam temperatures constant only 20 feet downstream from desuperheater outlet—regardless of changes in initial temperatures or rate of flow. No long runs of piping or spray nozzles are required. Other types are available, each engineered to particular operating requirements for steam service conditions through 2500 psig and 1100 degrees F. Write for Bulletin 1037.

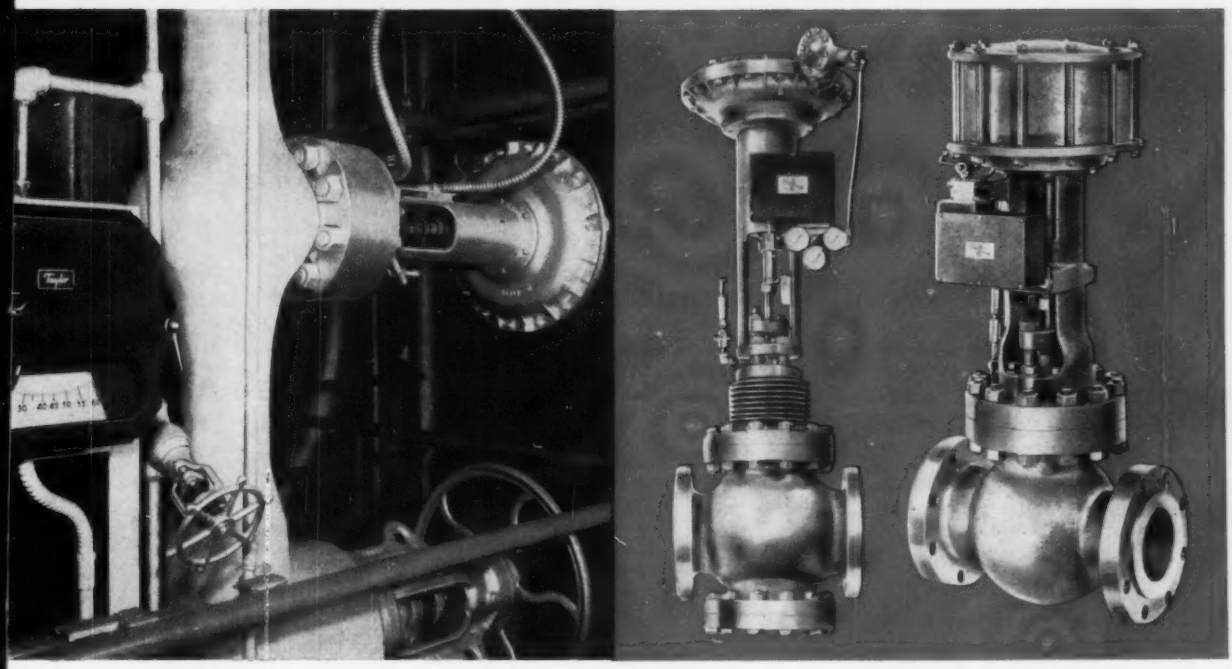
Copes-Vulcan equipment

With the country's electric power demand doubling every decade, power plants must operate with higher and higher efficiency. Boiler and boiler controls must be more closely integrated than ever before.

To meet these needs, Copes-Vulcan produces a complete line of control systems for superheat and reheat temperatures, feedwater, combustion, pressure reducing and desuperheating operations. Available in separate units or integrated into a single package, these control systems are custom-engineered to meet individual specifications, and are backed by more than 50 years design experience in the field.

Automated soot blowing. Vulcan Selective-Sequence Control Panel (at right) permits varying the operating sequence of electrically-driven soot blowers. Also available: Automatic-Sequential systems. Write for Bulletin 1029. The 35 foot Vulcan T-30 Soot Blower (below) has a dual-motor drive for thorough cleaning of all surfaces. Part of a complete line of soot blowers and wall deslaggers. Write for Bulletins 1030, 1034.





Boiler feed pumps are protected by this Copes diaphragm-operated by-pass valve. Also available: piston-actuated valves for use where valve operating force must be unusually high, and positioning precise. Both types, designed to meet pressure standards of 125-pounds through 2500-pounds, offer excellent rangeability. Each is job tailored for accuracy and dependability. Write for Bulletin 1027.

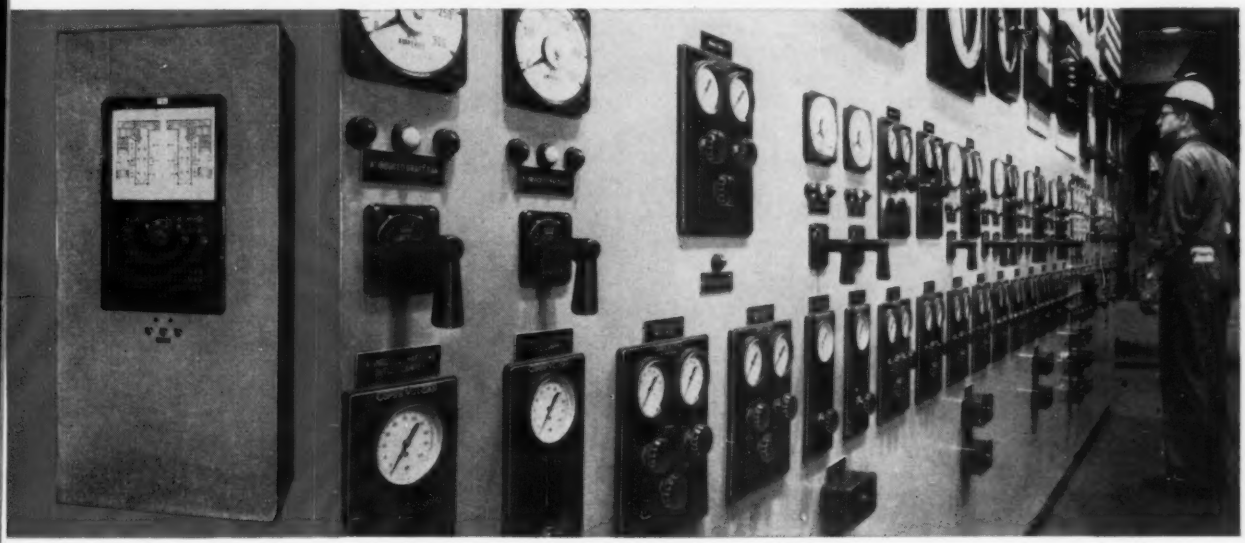
boosts power plant* efficiency

* *Thermal and nuclear:* besides intensive commercial product development, Copes-Vulcan is skilled and experienced in the design and manufacture of special products such as valves for the Navy's nuclear submarine program and for nuclear-powered electric generating stations.

COPES VULCAN | BLAW-KNOX

COPES-VULCAN DIVISION
Blaw-Knox Company, Erie 4, Pa.

Boiler control provides high speed response, simplicity of circuits and accuracy of components. Graphic panels centralize boiler operations at operator's fingertips. Combustion control may be from steam flow-air flow, or from fuel-air ratio. Feedwater control may be from one, two or three influences to maintain a stabilized water level regardless of changes in load or feed pressure. Write for Bulletin 1038.



For more facts circle 785 on Reader Service Card p 222

Boiler-Burner Team Wins Seven Straight

Phillips Chemical Company orders Vogt boiler and Coppus-Dennis FANMIX burner combinations to make 1¾ million pounds of steam an hour

When a customer praises a product, that's fine. But when a customer *continually re-orders*, that's conclusive proof of user-satisfaction.

Phillips Chemical Company, Borger, Texas — producer of synthetic rubber — first installed Henry Vogt boilers with FANMIX burners back in 1943. As plant production increased, Phillips again purchased the same equipment — in 1946, and again in 1951.

Today, a total of 7 Vogt boilers equipped with Coppus-Dennis FANMIX burners provide 1,750,000 lbs. steam each hour for the production of synthetic rubber. The boilers are designed for 250,000 lbs. steam peak operation but have been operated as high as 275,000 lbs. per hour. Their performance is typical of the efficiency of boilers equipped with Coppus-Dennis FANMIX burners.

FANMIX · Better Combustion · Better Efficiency · Higher Ratings

All Coppus-Dennis FANMIX burners — for gas as well as combination gas-oil — have the exclusive FANMIX action. Their *revolving orifices* give violent mechanical mixing and agitation of gas and air, therefore causing instantaneous and complete combustion with *minimum excess air* (5% excess air is not unusual).

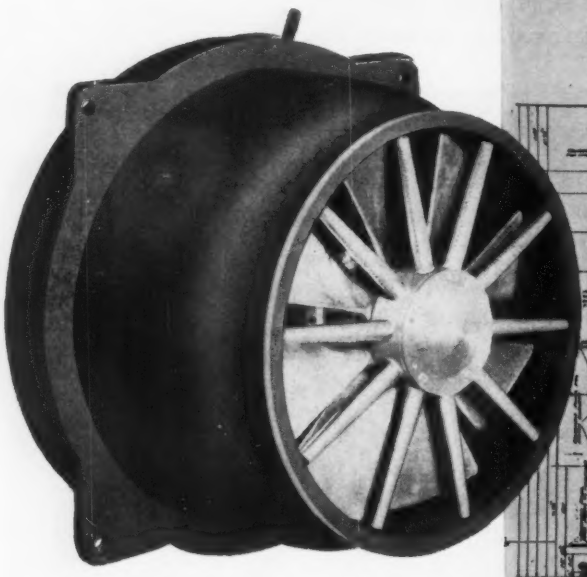
Because of this exclusive FANMIX action, furnace space is not required for mixing and *higher boiler ratings* are thus easily obtained. The burners also have a shorter flame than any other burner and will not cause flame impingement.

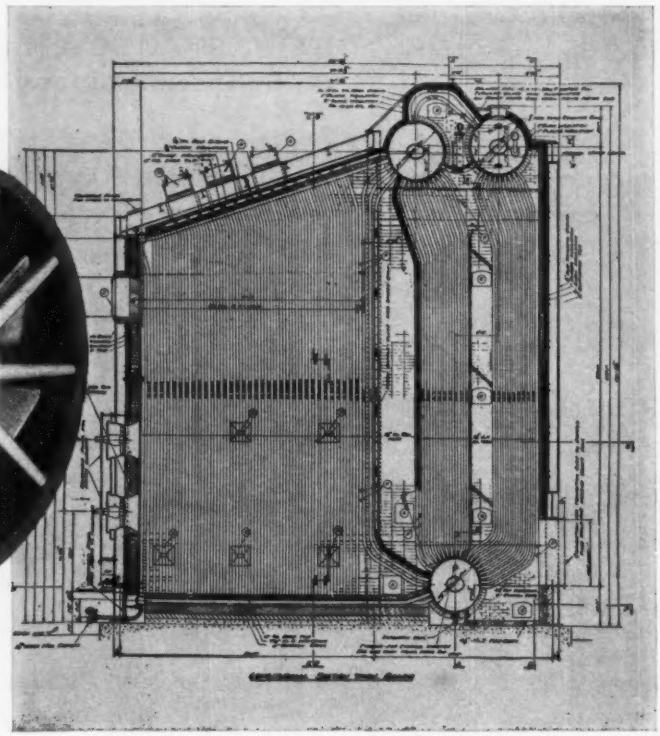
What's more, by incorporating a *fan* as an integral unit, FANMIX burners have *no draft loss* across the burner. As a result, increased ratings are possible regardless of draft conditions.

FANMIX action, with its quick completion of combustion, gives *lower* exit temperatures.

If you are not using Coppus-Dennis FANMIX burners in your present boiler, why not plan now to take advantage of the exclusive FANMIX action? You need no forced draft equipment, increase in stack or increase in furnace volume for FANMIX operation. And you get increased capacity. When specifying FANMIX on *new* boilers, you can plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity — and, of course, *no* forced draft equipment.

For further information, mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory* and *Mining Catalogs*.





JET REACTION is utilized to rotate fan which is integral part of burner. Ideal mixture for fast, complete combustion and peak efficiency is caused by automatically proportioned high velocity air passing at right angles through fuel.

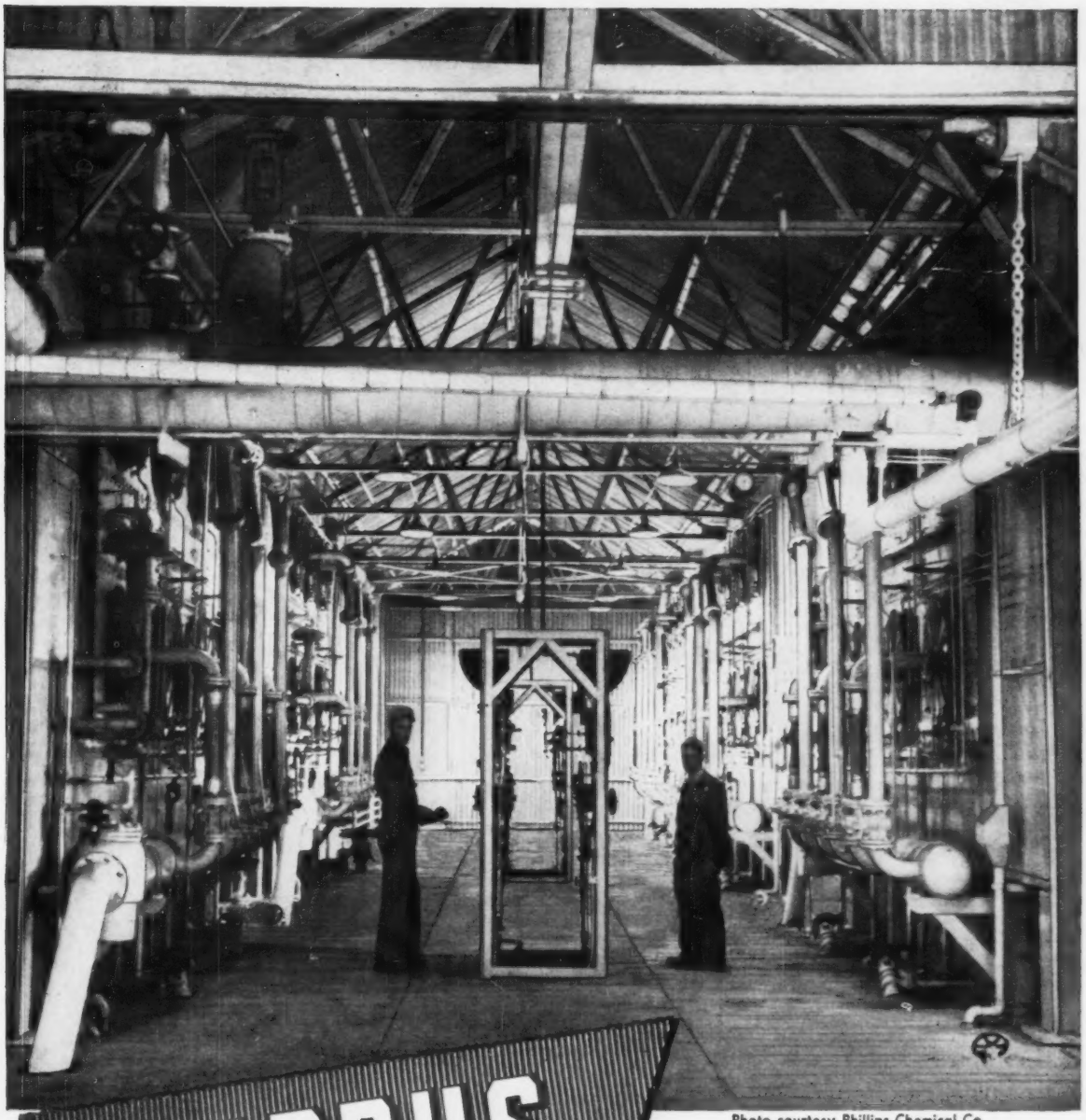


Photo courtesy Phillips Chemical Co.

HENRY VOGT BOILERS are here shown installed in the Phillips Chemical Company, Borger, Texas. Boilers use Coppus-Dennis FANMIX burners.

SEND COUPON for further information. Coppus engineers FANMIX burners to your individual requirements.

PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD

COPPUS ENGINEERING CORPORATION
170 Park Avenue
Worcester 2, Massachusetts

Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in ☐ gas ☐ combination gas-oil.

Name.....Title.....

Company.....

Address.....

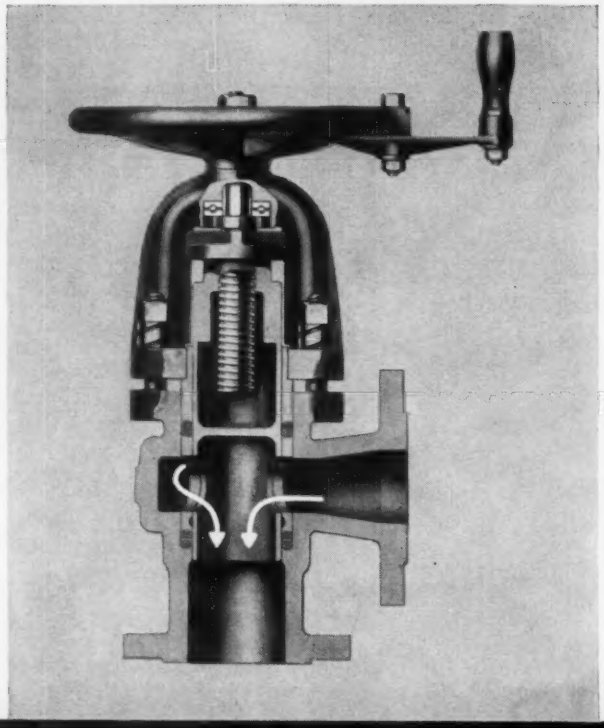
City.....Zone.....State.....

For more facts circle 786 on Reader Service Card p 222

These YARWAY VALVE DESIGNS

YARWAY SEATLESS

Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.



FOR LOW and MEDIUM PRESSURES

YARWAY HARD-SEAT

Features tough, stellite-faced and ground disc and seat ring, mated to provide smooth long-wearing surfaces. Stream-line flow. Alemite lubrication. MORE THAN 4 OUT OF 5 HIGH PRESSURE BOILER PLANTS USE YARWAY BLOW-OFF VALVES.

FOR HIGHER PRESSURES

USED IN OVER 15,000 BOILER PLANTS

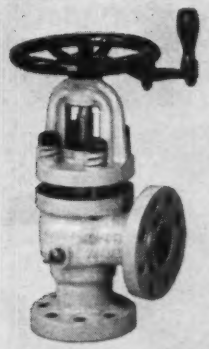
serve every boiler blow-down need

■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

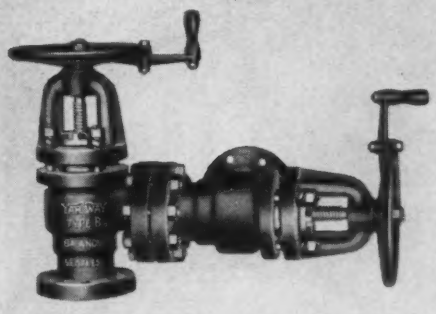
Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).

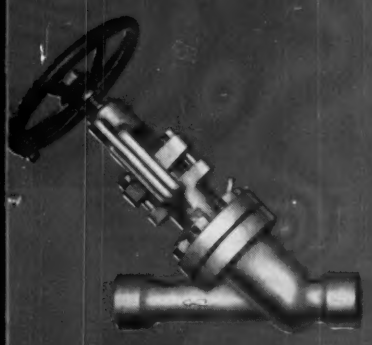


• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.



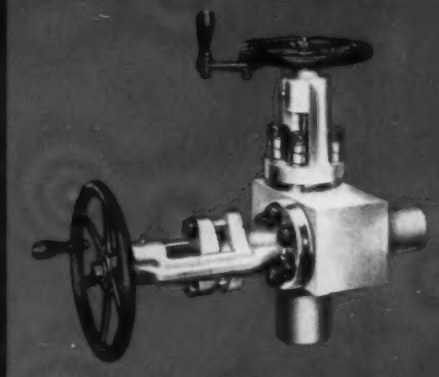
• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.

• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.



• Yarway Hard-Seat Blow-Off Valve for pressures to 2500 psi. Straightway valve shown. Angle available. Welded (shown) or flanged connections. See Bulletin B-434.

• Yarway Hard-Seat—Seatless Bolted Tandem Blow-Off Valve. Hard-Seat is the blowing valve, seatless is the sealing valve. Available in any combination of connections. For pressures to 1500 psi. Hard seat-hard seat tandems for pressures to 2500 psi. See Bulletin B-434.



• Yarway Unit Tandem Blow-Off Valve. Combines a hard-seat blowing valve and a seatless sealing valve in one-piece forged steel body for boiler pressures to 1500 psi. For pressures to 2500 psi, two hard-seat valves are combined. See Bulletin B-434.

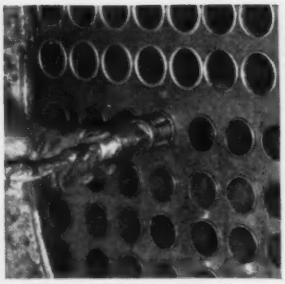
LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

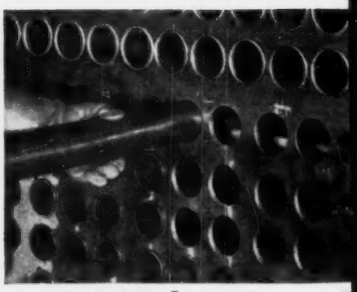
YARWAY

blow-off valves

For more facts circle 787 on Reader Service Card p 222



UNIFORM WALL THICKNESS. Every ELECTRUNITE Tube is made from flat-rolled steel closely controlled for wall thickness.



UNIFORM DIAMETER. ELECTRUNITE process of forming, welding, sizing, results in tubes uniform in diameter and concentricity.

Bird's-Eye View of Uniformity...

Republic ELECTRUNITE Boiler Tubing

Installed at LeTourneau-Westinghouse Plant

Power, key to productivity, demands a power plant designed and engineered to meet critical requirements and severe operating conditions of service. That is why Republic ELECTRUNITE® Boiler Tubes were specified for the new LeTourneau-Westinghouse Company installation at Peoria, Illinois.

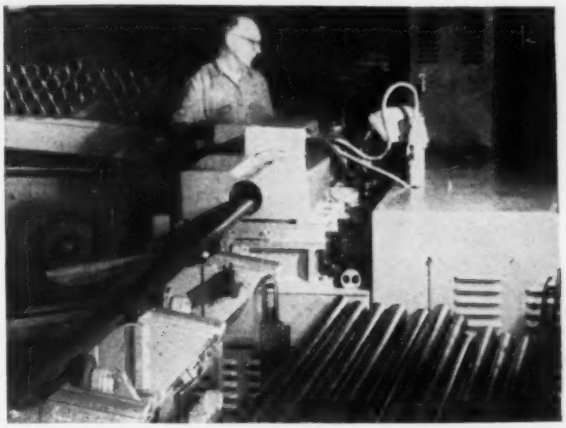
This new power plant, furnished by the Erie City Iron Works Company, Erie, Pennsylvania, has a designed capacity of 40,000 pounds of steam per hour and operates at 125 psi.

Each length of Republic ELECTRUNITE Boiler Tubing is hydrostatically or electronically tested to conform with the applicable ASTM specification and the ASME Boiler and Pressure Vessel Code, as well as local, state, and boiler-insurance requirements. And stress values for Republic ELECTRUNITE tubes are the same as those for tubes made by other processes for temperatures up to 850° F. ELECTRUNITE is available for pressures over 2000 psi. in various sizes and wall thicknesses.

Made of highest quality flat-rolled open-hearth steel produced in Republic's own mills, carefully controlled every step of the way, are reasons why more and more Republic ELECTRUNITE is specified by designers, engineers, and operators for vital steam generating units operating in every industry and community field.

For additional Republic ELECTRUNITE Boiler, Condenser, or Heat Exchanger Tubing facts, call your Republic representative or send coupon today.

QUALITY YOU CAN MEASURE—FARROWTEST®! Not a laboratory theory, not a mere inspection tool, but an exclusive production test that detects and rejects defects of critical size. FARROWTEST is offered as an alternative to other less positive tests in accordance with table below . . . at no extra cost.



Wall Thickness	Minor Dimension of the Defect (Length or Depth)	Length X Depth Area in Square Inches
20 ga.	.006"	.0025"
18 ga.	.006"	.003"
16 ga.	12½% of Wall	.003"
14 and 13 ga.	12½% of Wall	.004"
12 ga. and heavier	12½% of Wall	.005"

FARROWTEST detects and rejects defects completely penetrating tube wall, or equal to, or greater than, those shown in this table. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.

REPUBLIC STEEL

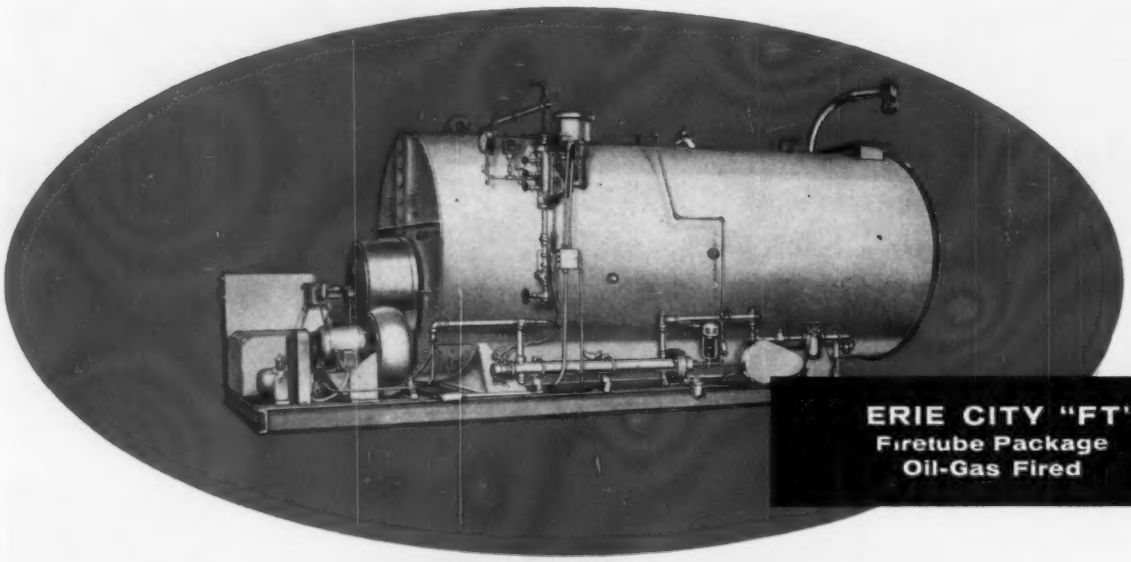
World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-5139-A
221 EAST 131ST STREET • CLEVELAND 8, OHIO
Please send the following literature:

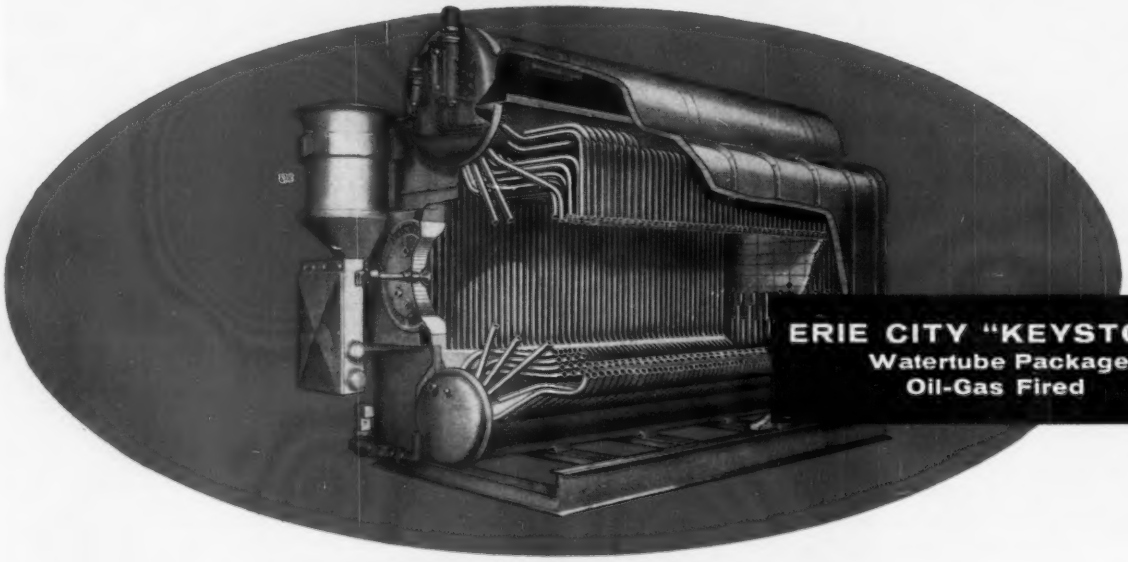
☐ ELECTRUNITE Boiler Tubes
☐ ELECTRUNITE Heat Exchanger Tubing
☐ Carbon ☐ Stainless ☐ FARROWTEST Brochure

Name_____ Title_____
Firm_____
Address_____
City_____ Zone____ State_____

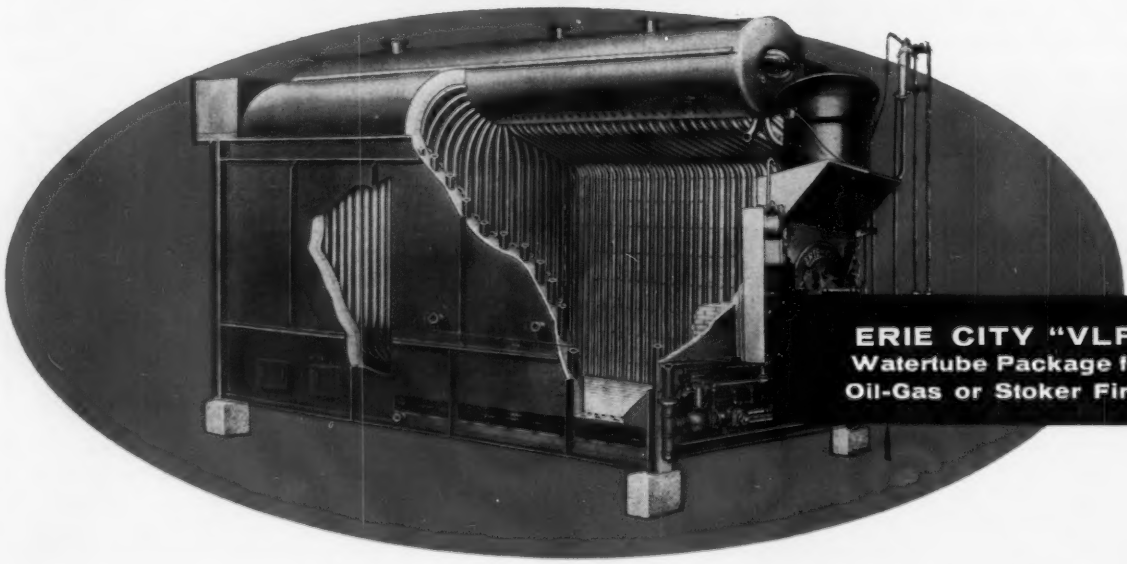
For more facts circle 788 on Reader Service Card p 222



ERIE CITY "FT"
Firetube Package
Oil-Gas Fired



ERIE CITY "KEYSTONE"
Watertube Package
Oil-Gas Fired



ERIE CITY "VLP"
Watertube Package for
Oil-Gas or Stoker Fired

Why shop around for Package Boilers?

Thinking about a new boiler these days? Maybe a package boiler! Sounds like a good idea because many people like this new concept of undivided responsibility. But what kind should we get? Firetube? . . . Watertube? Should it be oil fired, gas fired, arranged for future stoker firing; or which combination of these would be best for us?

The best place to find unbiased answers to your questions is Erie City Iron Works—a pioneer in the boiler industry and a leader in the package steam generator field. Erie City manufactures both firetube and watertube package units. Without prejudice their engineers can point out the advantages of both types.

After hearing the pros and cons of each, you may decide on the firetube type. Erie City offers its modern "FT" Package Boiler arranged with Erie City air atomizing oil gun and/or ring type gas burner. The "FT" Fire Tube Package unit is built to highest quality standards—not down to a price. It is a three pass design with gas vent at the rear and pressurized, using forced draft to provide precise control of excess air and CO_2. A centrifugal fan is used, which coupled to a closed combustion chamber, results in unusually quiet operation. No costly foundation—no expensive stack—no brickwork are required.

If a watertube boiler is your choice, you have two types available from Erie City. One is the KEYSTONE, the most compact water tube package available, arranged with a steam atomizing oil gun and/or ring type gas burner. The KEYSTONE is a baffleless, two drum unit completely water cooled with a seal welded inner casing and bolted outer casing for pressurized operation. No costly foundation—no expensive stack—no brickwork are required.

The other choice for a watertube package is the VLP. Your plant may be located in an area where gas, oil and coal are all available. At first you may decide to fire with oil or gas but desire the proper provision for future coal firing. The boiler for you to install is an Erie City VLP arranged for present oil and gas firing but with the furnace PROPERLY PROPORTIONED for the future installation of an underfeed or spreader stoker.

All Erie City package units come complete with burners, fans and safety and combustion controls, piped, wired and mounted on the boiler. No field work required—just make basic fuel, water, steam and electric connections and you're ready for operation.

Both the air atomizing and steam atomizing burners are of Erie City's own design and manufacture. No division of responsibility here. Qualified service engineers will assist at start up and instruct your operating personnel. In the case of the VLP, your boiler will be properly designed for future conversion to either Erie City underfeed or spreader stoker firing. Again, no division of responsibility.

Don't let the selection of a new boiler become an unnecessary problem. Write and let Erie City help make the proper selection of a package steam generator for you.

"FT" *Cat.* SB5681K

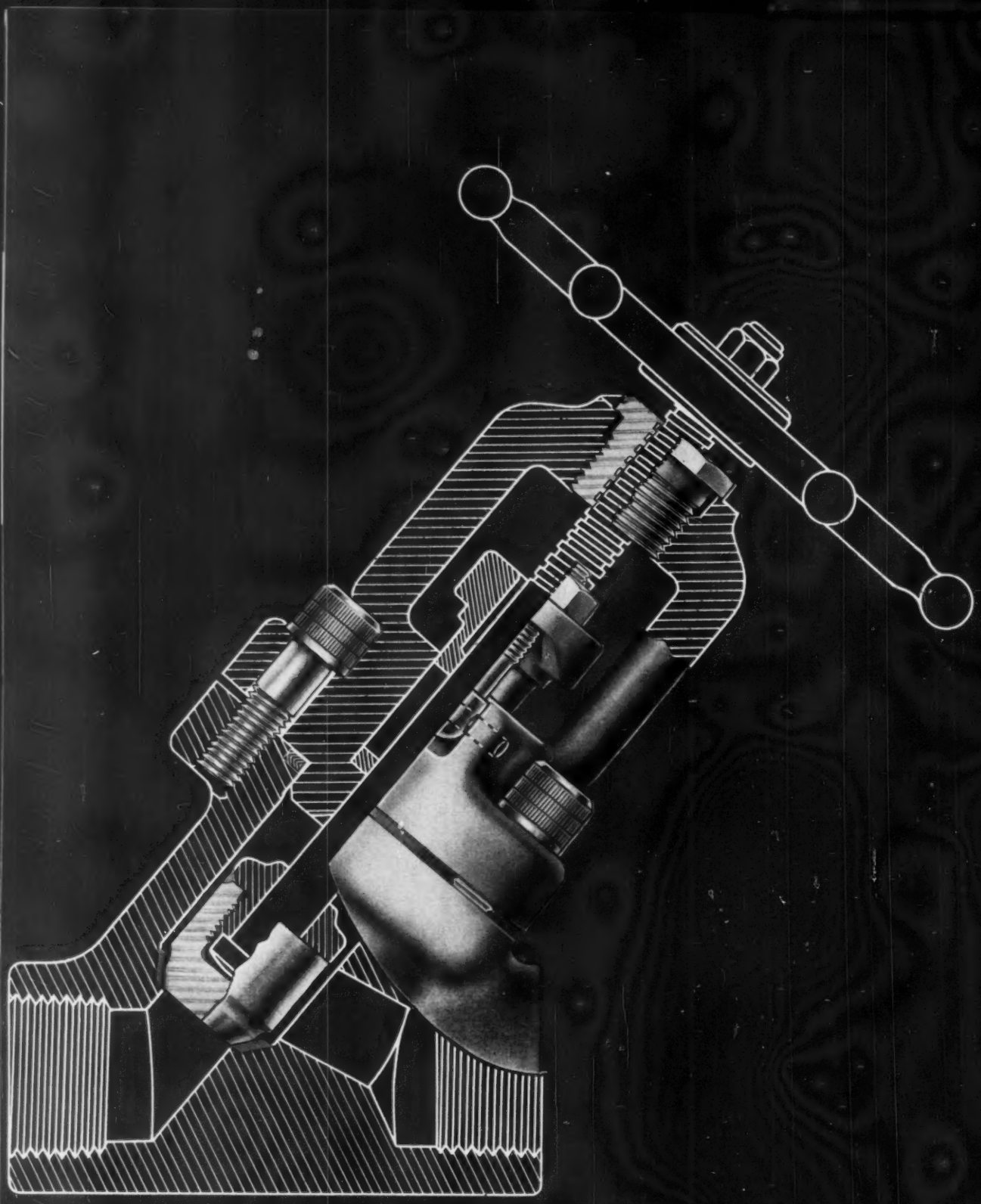
"KEYSTONE" *Cat.* SB5981K

"VLP" *Cat.* SB5781K

• *You can depend on* ERIE CITY Since 1840 *for sound engineering*

ERIE CITY IRON WORKS *Erie, Pennsylvania*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS • WASTE HEAT BOILERS
FIRE and WATER TUBE PACKAGE BOILERS • OIL and GAS BURNERS • STOKERS • PULVERIZERS



EDWARD "848" SERIES GLOBE VALVE
(ANGLE TYPE ALSO AVAILABLE)

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Major Improvements at No Extra Cost Mark New "848" Series Forged Steel Stop Valves

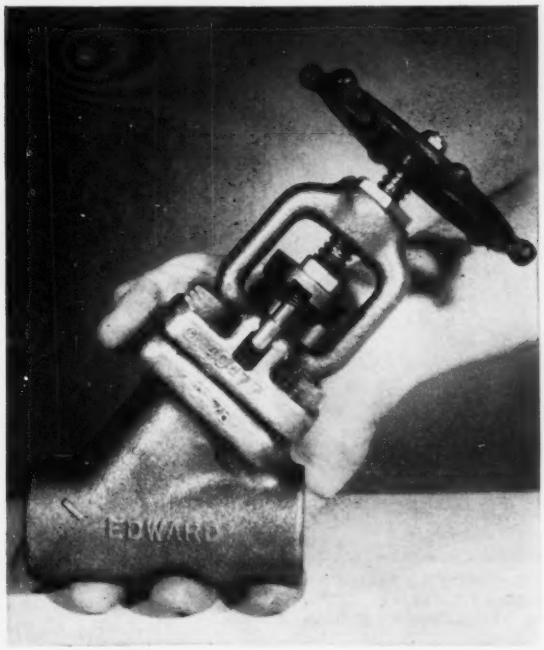
In an industry where any change in design is "news," Edward is proud to introduce a new line of 600-lb forged steel stop valves with so many major design improvements *at no increase in cost.* These Rockwell-built Edward valves are suitable for air, water, oil and other hydrocarbons, anhydrous ammonia and other gases, steam and other non-corrosive fluids.

NEW MATERIALS USED THROUGHOUT

Besides tough drop-forged steel, which is the basis of these valves, Edward introduces such innovations as stainless steel gland bolts, an aluminum-bronze yoke bushing, solid disk of chromium-cobalt-tungsten stainless steel, spiral wound gasket of stainless steel and asbestos, and special alloy cap screws linking body and bonnet.

NEW IMPROVED BODY-BONNET JOINT

Four molybdenum alloy cap screws secure bonnet to valve body. These compact, high-strength cap screws require less space than ordinary nuts and bolts, can be handled with one hand, and deliver maximum compressive force with minimum tightening torque. A new spiral wound gasket, consisting of some 20 turns of stainless steel and asbestos, provides controlled compression not possible with ordinary flat gaskets. Because this spiral wound gasket is free to expand and contract as needed, it "takes up the slack," maintains a leak-proof seal between body and bonnet.



NEW SOLID DISK OF SPECIAL ALLOY

Disk is made of chromium-cobalt-tungsten stainless steel. This new alloy has added resistance to erosion, holds its hardness better under high temperatures than other disk materials. Disk is lock-welded to disk-nut, eliminating wobble and chatter—especially important when valve is called upon for throttling duty.

INTEGRAL STELLITE SEAT FOR LONG LIFE

Valve seat is Stellite—a harder, longer-wearing material with excellent resistance to corrosion, erosion and temperature. Seat is integrally welded to body.

"848" SERIES ROCKWELL-BUILT EDWARD VALVES are available in ¼", ⅜", ½", ¾" and 1" sizes. They are rated at 600 psi—at 910F in carbon steel and at 1030F in chrome-molybdenum steel. Globe or angle types, with screwed or welding ends. Write for facts on performance . . . price . . . and delivery. Address *Edward Valves, Inc., 1200 West 145th Street, East Chicago, Indiana.* (Subsidiary of Rockwell Manufacturing Company.) Represented in Canada by Lytle Engineering Specialties, Ltd., 360 Notre Dame St. W., Montreal 1, Quebec.

EDWARD STEEL VALVES

another fine product by

ROCKWELL

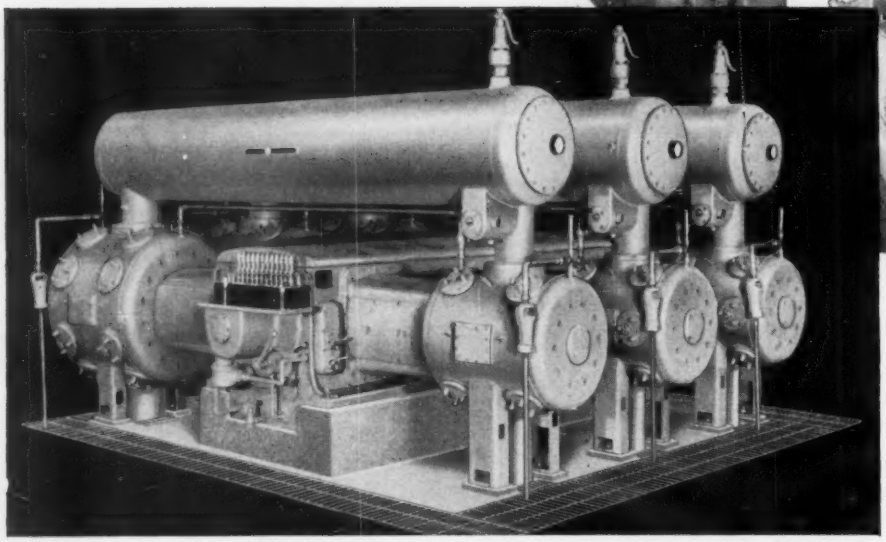
Catalog 14 contains full data on the complete Edward line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, instrument, gage and special designs; for pressure up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets, with screwed, welding or flanged ends.

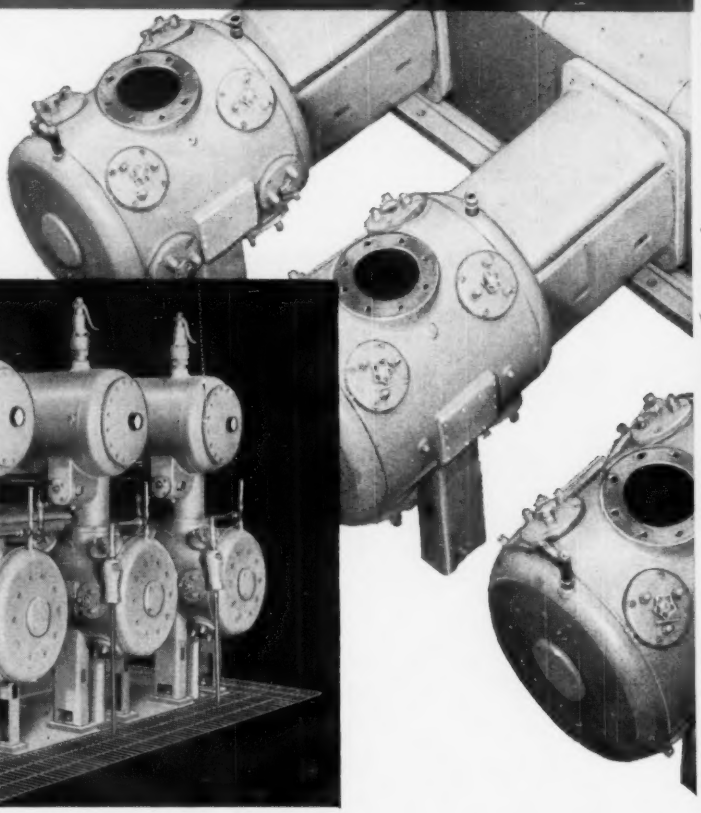
For more facts circle 935 on Reader Service Card p 222

BUILT FOR

- *for vacuum service or pressures to 15,000 p.s.i.g.*
- *in sizes to 5,000 H.P.*
- *for direct motor mounting, flexible coupling or gear drive*

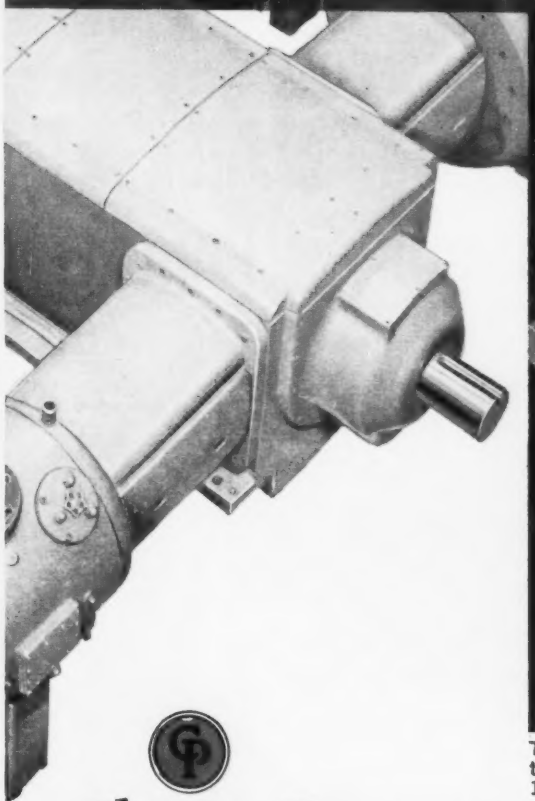
CLASS FE

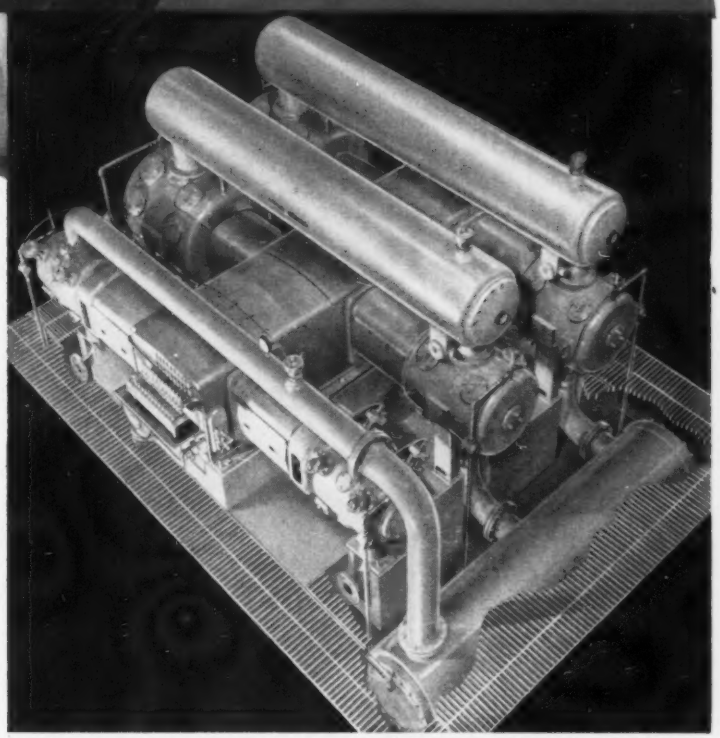




The six-cylinder compressor unit in the background photo above represents but one of numerous cylinder-crankthrow arrangements obtainable with the balanced-opposed Class FE. The unit shown directly above is a two-stage arrangement, 1000 H.P. size, one of two recently purchased by a large engine manufacturer.

HEAVY-DUTY COMPRESSORS





The high pressure compressor above is a further example of the flexibility of the balanced-opposed design. Here, the six-cylinder arrangement is used in a 1,250 H.P. three-stage compressor for wind tunnel service.

Chicago Pneumatic

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

For more facts circle 936 on Reader Service Card p 222

90% open spacer in new Exide-Manchex gives you more power, sustains it longer

Now even better. New-design Exide-Manchex Batteries feature (1) suspended plates; (2) high level electrolyte; (3) large sediment reservoir — dependable power for added years of use.

In between the plates of every new Exide-Manchex Battery there's an extra-thick layer of power-sustaining electrolyte that other plante-type batteries don't have. When the positive plate needs acid to meet a sustained load, the Exide-Manchex can supply it—quickly and in ample amount to produce the needed power at a higher end voltage.

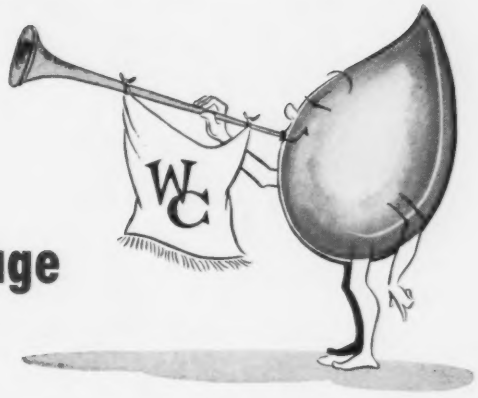
This is only one of the practical ways you benefit from the new 90% open spacer now used in new Exide-Manchex Batteries. In addition, ions are freer to travel back and forth between the plates—during both normal and high current conditions. The greater open area reduces the battery's internal resistance. Hence it holds its voltage longer under high load. It is less subject to internal heating. And its life potential is significantly prolonged.

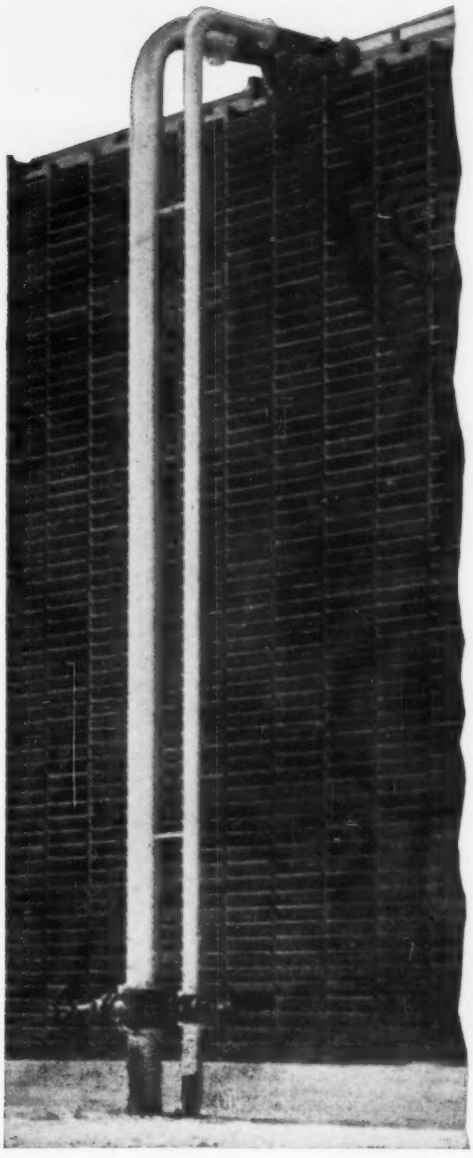
With this new design, Exide engineers have succeeded in making the world's most famous long-life battery even better. When you order batteries for float or cycle service in stationary applications, get the most value for your money. Specify Exide-Manchex. For detailed information, write Exide Industrial Division, The Electric Storage Battery Company, Phila. 2, Pa.

Exide®

For more facts circle 937 on Reader Service Card p 222

An important message to men with algae problems





Get safe, quick control with Allis-Chalmers No. 120 Series Algaecide

This low-cost way to kill algae was introduced by Allis-Chalmers two years ago. It has proved an ideal solution to problems of plugged pump strainers, coated heat exchanger tubes and coated slats in cooling towers.

Many Advantages

- **Safe** — Even in concentrated form it is only a mild irritant to skin and eyes.
- **Easy handling** — Pump, drip feed or manual feed can be used. No expensive feeders needed.
- **Non-oxidizing**
- **Corrosion inhibiting**
- **Service proved**
- **Economical** — Only 2 to 5 ppm required for effective dosage of most organisms.
- **Long lasting** — No loss of algaecide on passage through cooling tower.
- **Low toxicity** to fish or animals.

Number 120 Series Algaecide is toxic to more algae than any other algaecide. For complete information, call your nearby A-C office, or contact Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 28X8434.

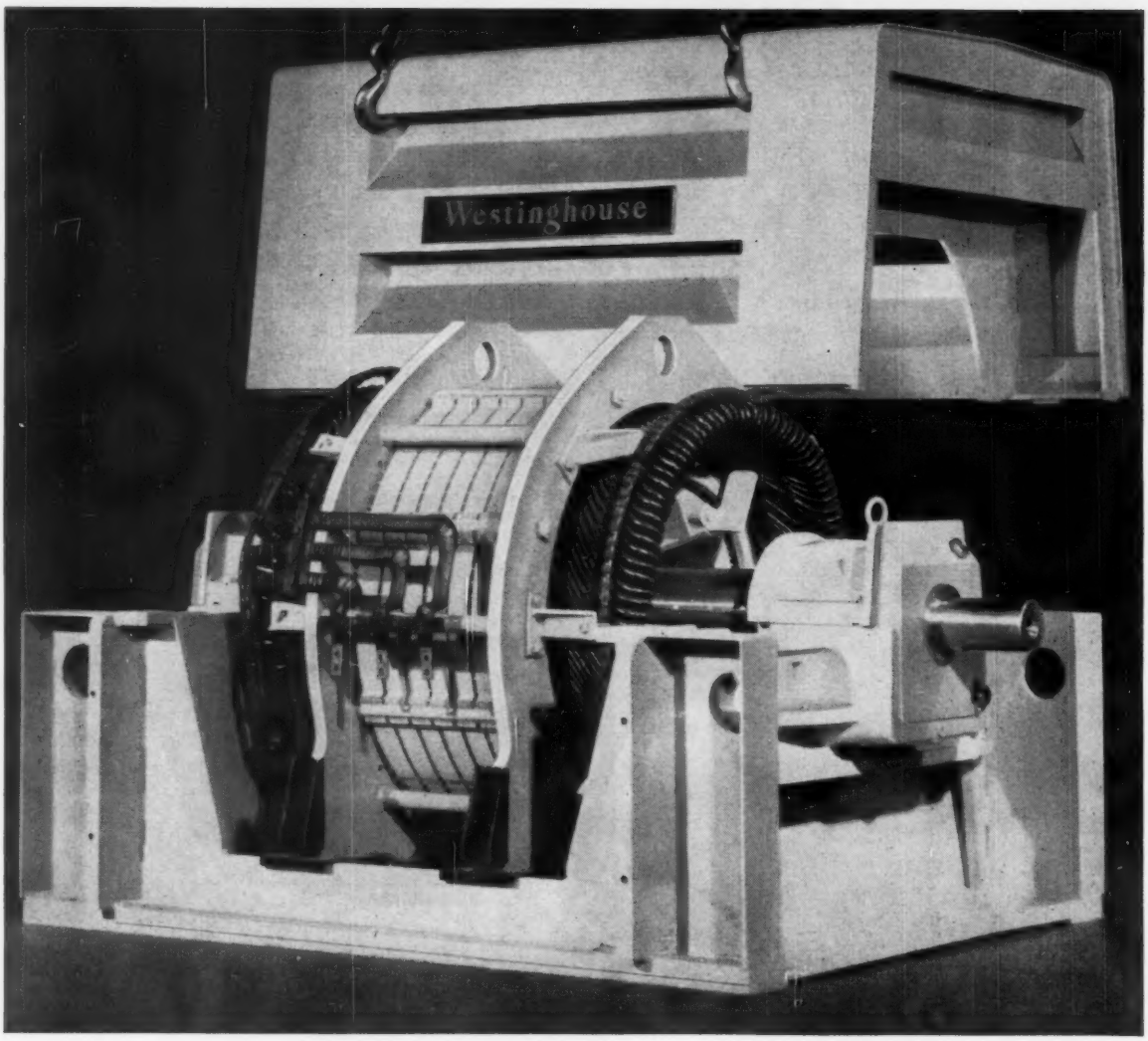
A-C ALLIS-CHALMERS

ALLIS-CHALMERS

A-5773

For more facts circle 938 on Reader Service Card p 222

Revolutionary new Westinghouse F/A Motor gives you five major advantages



First fully accessible motor ... takes guesswork out of inspection

For the first time in large motor history, the motor housing is completely separate from the stator, with all the benefits such construction implies.

Inspection — once a matter of partial visibility and guesswork — is now a thorough and easy operation which insures your motor investment. Advantages impossible in conventional motors are standard features of this F/A Motor design.

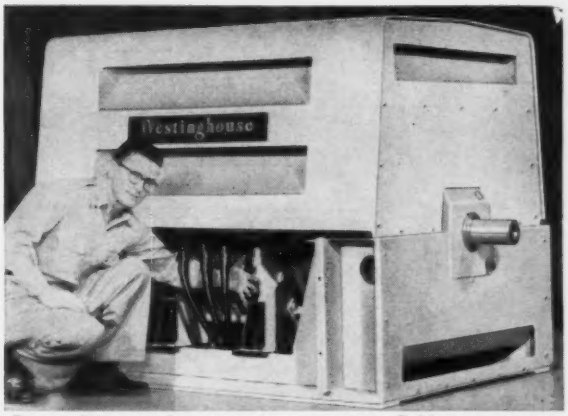
1. Full accessibility. Total inspection is possible for the first time. Enclosures are quickly removed, easily replaced. Reassembly is automatically precise.
2. Inherently quiet. Housing is isolated from the stator, reducing transmission of vibration and noise.
3. Thermalastic® insulation. Recognized as the finest available, it assures long life and protection of coils.
4. The same basic components — rotor, stator, bearings — which have made Westinghouse motors famous for long, efficient service life.
5. Easy to connect. No conduit box. Cables pass through the base bottom with extra-ample room to connect motor leads.

These and many other qualities make the new Westinghouse F/A Motor your best investment. It is presently available in large induction motors, both squirrel-cage and wound rotor. Various types of enclosures include dripproof, splashproof, weather protected, force ventilated, enclosed self-ventilated with cooler and TEFC tube type. Horsepower ratings range from 250 up to 7000, depending on speed.

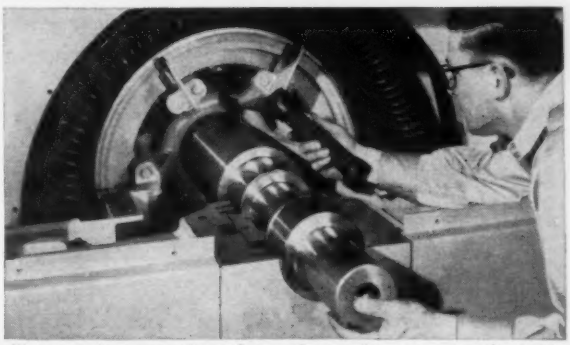
For full information, call your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-15011

YOU CAN BE SURE...IF IT'S Westinghouse

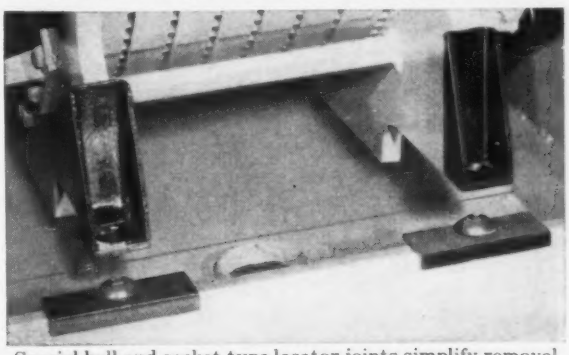


Protruding conduit boxes are gone. Cable comes up through the base, leaving plenty of room for connecting motor leads.



By merely removing the end panels, you can inspect windings and bearings.

Remove bearing cap, top bearing shell and oil ring; then the bottom bearing shell rolls out for easy inspection.



Special ball and socket type locator joints simplify removal and replacement of stator. In reassembly, perfect realignment is automatic.

For more facts circle 939 on Reader Service Card p 222

"Under Way On Nuclear Power"

Aug. 8, 1958

Congratulations to the Nautilus, the world's first sub to chart a passage under the North Pole.

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

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DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

January 17, 1955

As she blinked this terse message, the *USS Nautilus* cast off and steamed to sea leaving an old era of oceanic travel in its wake.

This is the first nuclear-powered, steam-turbine-driven submarine ever to be built. With the eyes of the world watching, it was a project with no margin for failure. Exhaustive sea trials which tested every feature of her equipment proved that the only acceptable result—success—had been completely realized.

We take pride in Walworth's share in this momentous achievement. For, from the days when the *Nautilus* was still on the drawing board to the last stage of construction, Walworth engineers worked directly with the Electric Boat Division of the General Dynamics Corporation—helping with the myriad of piping problems this new concept of transportation posed. Now the *Nautilus* prepares to join the fleet with Walworth Valves and Fittings, both standard and special items, installed.

We are glad to be aboard.

For more facts circle 940 on Reader Service Card p 222

For more facts circle 941 on Reader Service Card p 222 →

Approximate
Service Limit Brand
3200°F. Castolast (Castable)
3100°F. H-W High Alumina Castable
Apache (Plastic Fire Brick)
3000°F. Chromepak (Casting Mix)
H-W Super Plastic Fire Brick
Apache G (Plastic Fire Brick with Graphite added)
2900°F. H-W Black Patch (Plastic Fire Brick)
2800°F. Harcast (Castable)
2700°F. H-W Super Castable
2600°F. H-W Lightweight Castable 2600
Harchrome (Castable)
H-W Chrome Castable
2500°F. H-W Standard Castable
H-W Periklase Castable
H-W Baffle Mix (Castable)
2400°F. H-W Extra Strength Castable
2300°F. H-W 85 Lightweight Castable
2200°F. H-W 56 Low Iron Castable
H-W 56 Lightweight Castable
1800°F. H-W 25 Lightweight Castable
1500°F. H-W Castable RC

The complete series of HARBISON-WALKER PLASTIC and CASTABLE REFRACTORIES

can assure the proper selection for maximum life and economy

In addition to the wide range of service temperature limits as here illustrated, these monolithic refractories possess the many different combinations of physical and chemical properties needed for best protection against widely diversified destructive factors. From these brands the best balanced selection can be made for adequately withstanding the most severe operating conditions. Some examples of the many destructive influences against which maximum resistance is needed, are: corrosion by slags, fuel ash and various other fluxes; thermal shock; disintegrating action of gases; erosion by molten metals and slags; mechanical stresses at the high working temperatures.

To help secure maximum service from these refractories, Harbison-Walker freely offers engineering service, recommendations based upon wide experience, and quality-controlled products.

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AND SUBSIDIARIES GENERAL OFFICES: PITTSBURGH 22, PA.
World's Most Complete Refractories Service

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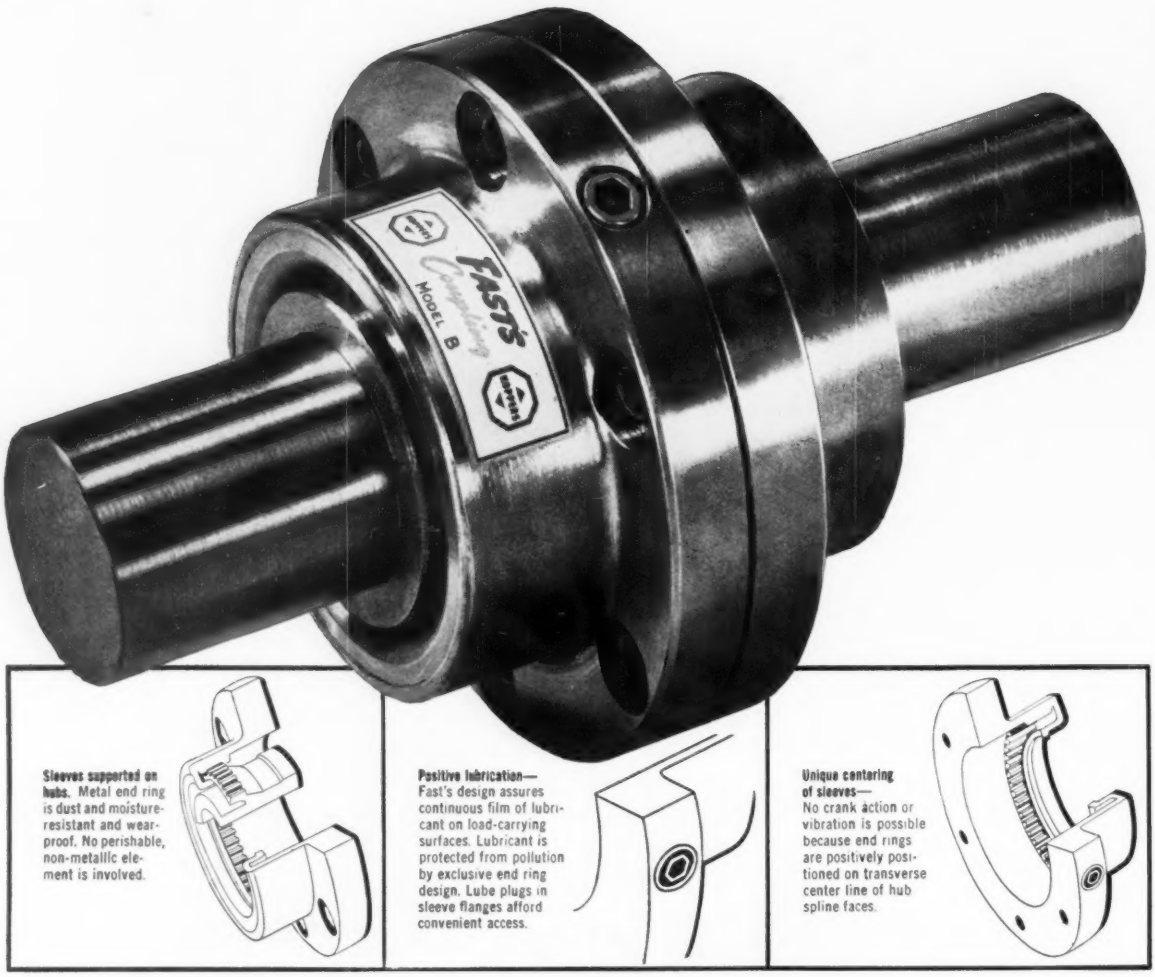

FAST'S
Coupling
MODEL B
Sleeves supported on hubs. Metal end ring is dust and moisture-resistant and wear-proof. No perishable, non-metallic element is involved.
Positive lubrication— Fast's design assures continuous film of lubricant on load-carrying surfaces. Lubricant is protected from pollution by exclusive end ring design. Lube plugs in sleeve flanges afford convenient access.
Unique centering of sleeves— No crank action or vibration is possible because end rings are positively positioned on transverse center line of hub spline faces.

Fast's Model B coupling reduces downtime and upkeep for light-to-medium drives

Mechanical flexibility eliminates costly shutdowns and expensive shaft replacements. But—it's only one of many cost-saving features.

Now you can profit from the durability and economy of famous Fast's couplings in a smaller and lower-cost version—available in 5 sizes for shafts ½" to 3⅛" in diameter.

The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free performance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

Write today for more details to KOPPERS COMPANY, INC., Fast's Coupling Dept., 3310 Scott Street, Baltimore 3, Md.

Engineered Products
Sold with *Service*

KOPPERS

THE ORIGINAL
FAST'S Couplings

For more facts circle 942 on Reader Service Card p 222

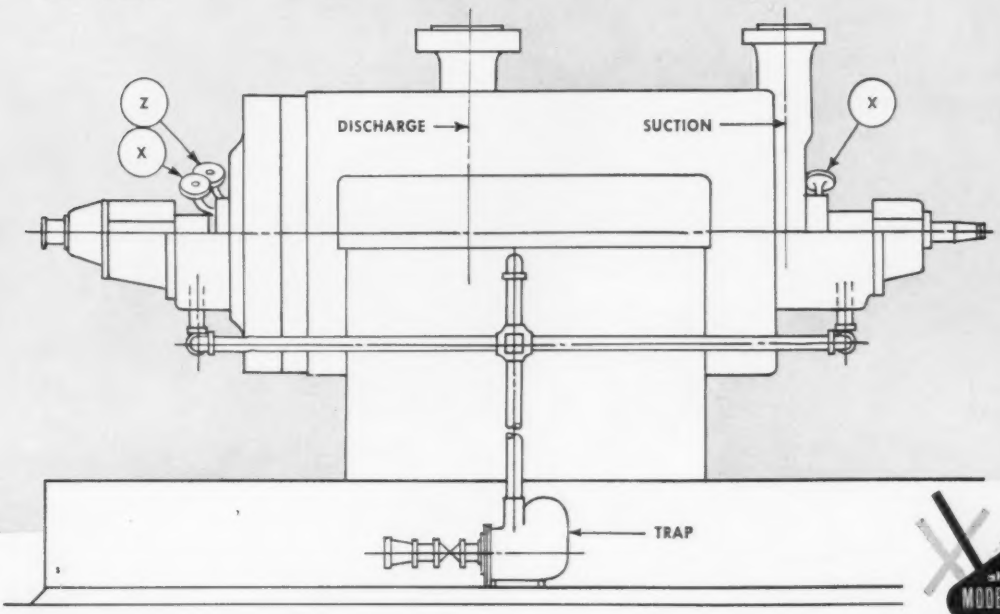
Each of these towers has a capacity of

Arrangement of packingless sealing shows low-maintenance provisions. Condensate is piped to each stuffing box through line X. Condensate flows through an inner and then an outer serrated bushing. Drip catcher gathers condensate at each end — permits condensate to flow by gravity to a collecting trap. Condensate leakage is drawn back into the system by means of a condenser vacuum. Where no vacuum is present, an overflow pipe keeps leakage from entering the bearing bodies.

Line Z takes the high pressure bushing leakage back to the pump suction or to a heater. A needle valve following the trap will control flow back to the condenser.

Optional Sealing Arrangements

In addition to packingless seals, Allis-Chalmers offers standard packing, condensate bleed-in bleed-off arrangement, or mechanical seals — depending on your specific requirements.



Plan to stay ahead... MODERNIZE!

PACKINGLESS SEALS

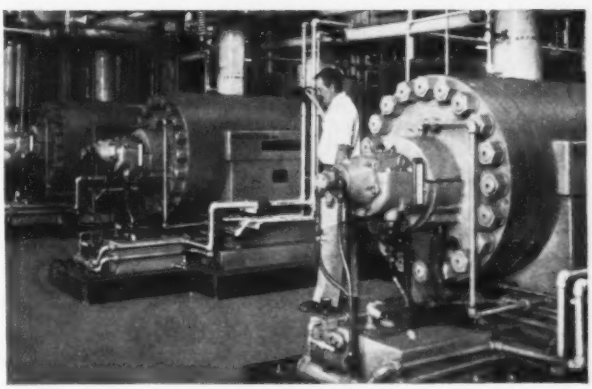
in ALLIS-CHALMERS barrel-type pumps

require no operator maintenance

Proven by performance in numerous power plants, the packingless seal arrangement available in Allis-Chalmers pumps means new station-operating economies. Here's why:

- Operator maintenance of stuffing box eliminated.
- No cooling water required for jacket and gland.
- Selection of smaller heater drain pumps often permitted.

Coupled with this low-maintenance design is the ultimate in efficiency that makes A-C barrel-type boiler feed pumps the most modern power plant pumps available. Contact your A-C representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

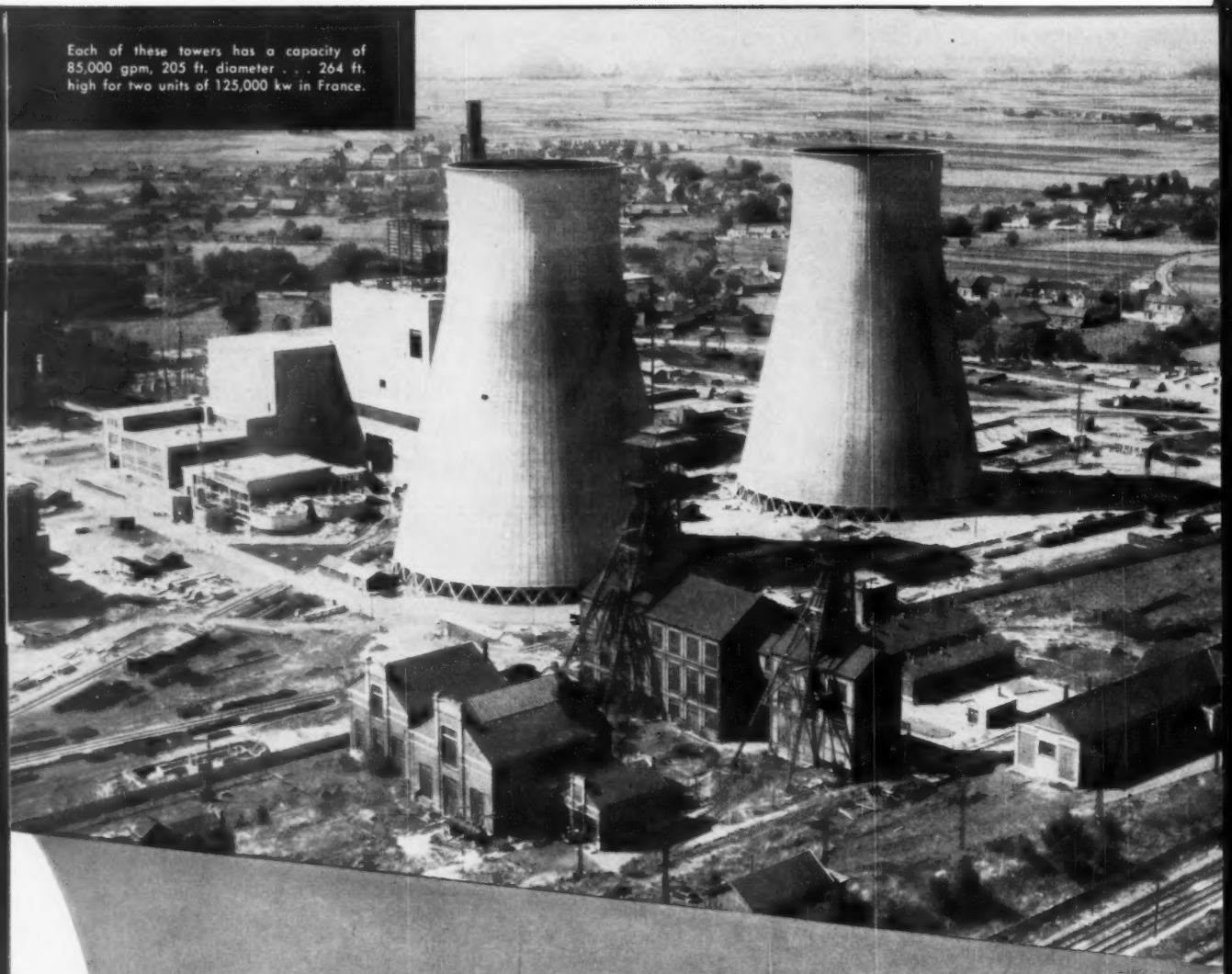


ALLIS-CHALMERS

A-5544

For more facts circle 943 on Reader Service Card p 222

For more facts circle 944 on Reader Service Card p 222→



Each of these towers has a capacity of 85,000 gpm, 205 ft. diameter . . . 264 ft. high for two units of 125,000 kw in France.

AIR DRAFT SELF GENERATED INSIDE A REINFORCED CONCRETE STACK
UP TO 350 FEET HIGH

FILLING & HOT WATER DISTRIBUTING NET OF ASBESTOS CEMENT
SUPPORTED BY REINFORCED CONCRETE FRAMEWORK

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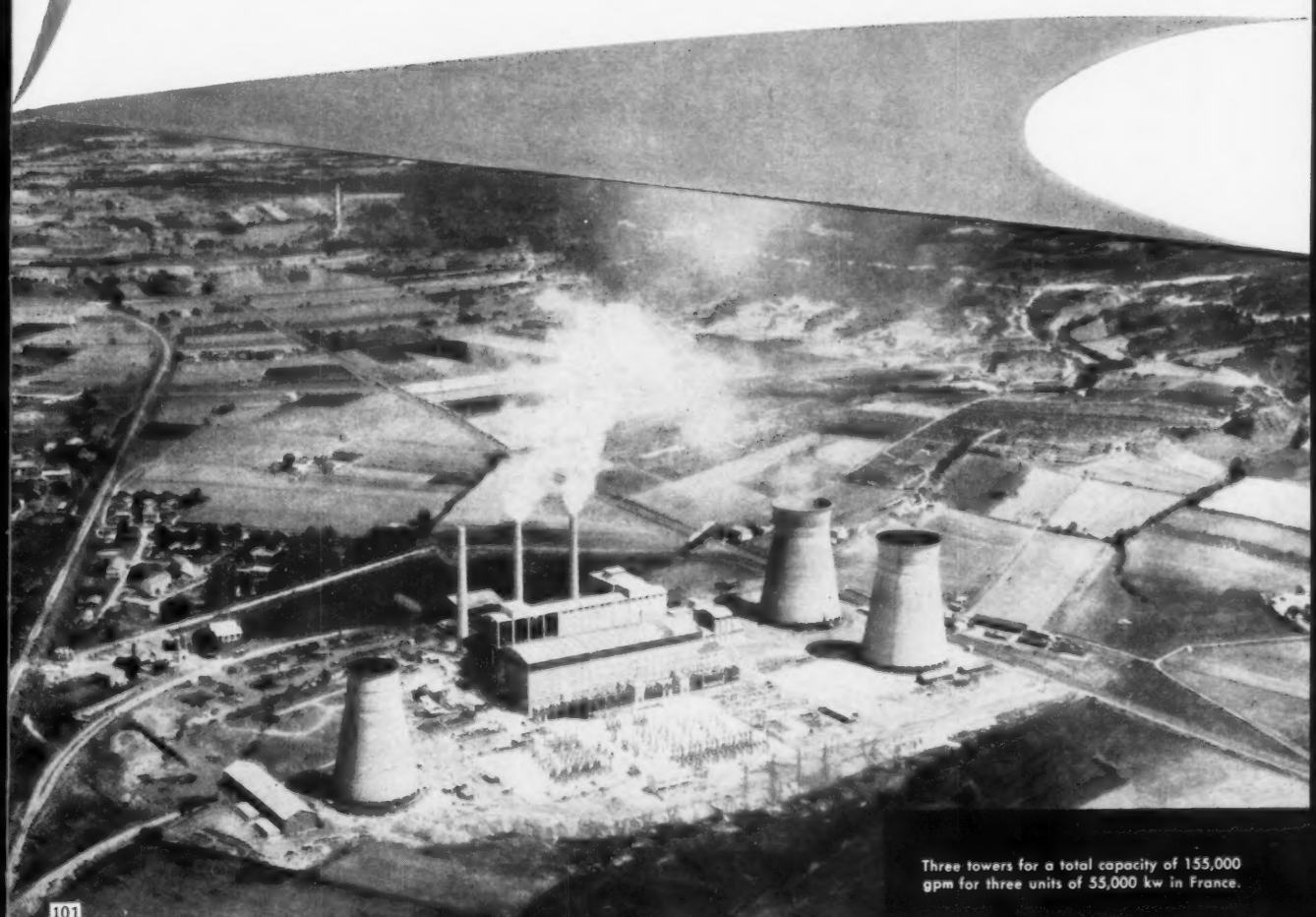
For more facts circle 943 on Reader Service Card p 222

For more facts circle 944 on Reader Service Card p 222➤

HAMON

NATURAL DRAFT COOLING TOWERS

HALF A CENTURY *OF EXPERIENCE!..*



Three towers for a total capacity of 155,000 gpm for three units of 55,000 kw in France.

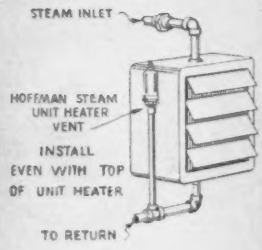
FOR MAXIMUM EFFICIENCY

USE HOFFMAN VENTS

To get top performance on Steam Unit Heaters, Steam Heating Systems, Steam Process Work, Hot Water Heating Systems, Domestic Water, Summer-Winter Units—Water Process work, air must be eliminated. Hoffman Vents are designed to vent the air accumulations so that the equipment will function effectively.

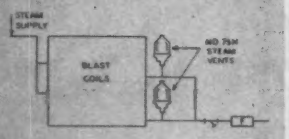
Installation of these vents now on old or new jobs will insure the maximum efficiency of the equipment.

NO. 74 VENT FOR STEAM UNIT HEATERS



To insure best results, Steam Unit Heaters must be "piping hot." The No. 74 vent is a float type vent especially designed for use with Steam Unit Heaters. This vent will expel the air as it accumulates.

Size Connection: ¾" male, ½" female. Maximum Operating Pressure: 35 P. S. I.

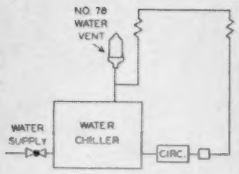


NO. 75 H STEAM VENT

An air vent for systems, supplied with steam from constant source such as District Heating, Pressure Reducing Stations and Zoned Systems.

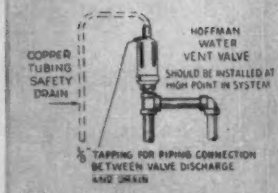
Size Connection: ¾" male, ½" female. Venting Pressure: 10 P. S. I. System Pressure: 15 P. S. I.

NO. 78 HIGH PRESSURE WATER VENT



Designed for use on high pressure hot or cold water mains and process applications. Cast brass body. Safety drain connection for discharging moisture entrained in the vented air. Has drain tube fitting and ferrule for ¼" O.D. tubing.

Size Connection: ¾" male, ½" female. Maximum Operating Pressure: 150 P. S. I.—will withstand hydrostatic pressures of 450 P. S. I.


COPPER TUBING SAFETY DRAIN
HOFFMAN WATER VENT VALVE
SHOULD BE INSTALLED AT HIGH POINT IN SYSTEM
⅜" TAPPING FOR PIPING CONNECTION BETWEEN VALVE DISCHARGE AND DRAIN

NO. 79 WATER VENT

For good circulation on any water system (hot or cold) it is necessary to let the air out. The No. 79 vent is designed for use on hot or cold water mains and process applications. Tapped at top for ⅛" I. P. S. safety drain connection for discharging moisture entrained in the vented air.

Size Connection: ¾" male, ½" female. Maximum Operating Pressure: 75 P. S. I.

HOFFMAN SPECIALTY MFG. CORP.

1700 W. 10th Street, Indianapolis 7, Indiana

Valves, Traps, Vacuum and Condensation Pumps, Forced Hot Water Heating Systems, stocked and sold by leading Wholesalers of Heating and Plumbing Equipment.

For more facts circle 790 on Reader Service Card p 222

FOR COAL BUNKER NOSES,
CHUTES, HOPPERS, SPREADERS THAT MATCH
THE LIFE OF YOUR BOILER...

Take a comptroller's-eye view of Lukens Clad Steel

■ He sees savings ... and so will you! In bunker noses and other coal handling equipment, Lukens clad steel puts a virtual stop to costly coal hangups and to damage from sulfuric acid in wet coal. Its durability is proved by installations more than 10 years old which show no measurable wear—ample evidence that it will match the life of your boiler.

Further savings accumulate from its ready fabrication, easy modification, and through freedom from down time and maintenance. The reasons:

Helping industry choose steels that fit the job

Lukens clad steel is not a lining but a solid plate—one side corrosion resistant stainless steel permanently joined in a metallurgical bond to a rugged yet economical backing steel.

Lukens will help you and your fabricator select the proper types and gages to fit your needs. *Bulletin 740 will give you performance facts and production information.* Send in the coupon and ask for the names of experienced coal handling equipment builders. Lukens Steel Company, Coatesville, Pennsylvania.

SEND FOR THIS BOOKLET TODAY!

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Please send me a free copy of your 16-page booklet, "Stainless-Clad Steel for Coal Handling."

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For more facts circle 791 on Reader Service Card p 222

For more facts circle 792 on Reader Service Card p 222 →

Why cost conscious engineers specify

Research-Cottrell

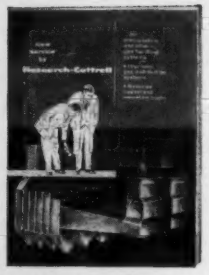
Model Studies

One of the biggest problems in getting the most out of precipitators has been proper gas distribution at the precipitator inlet. Until recently this has been largely a matter of educated guessing.

Now, by using three dimensional, transparent scale models, Research-Cottrell has taken the "guesswork" out of engineering gas handling systems. Both major and minor design changes are made inexpensively on these scale models and the effects on gas flow studied. Correlation between models and full scale installations has proven the reliability of Research-Cottrell's new pre-installation techniques.

Briefly, here are the advantages of Research-Cottrell's gas flow model studies:

- Higher collection efficiency—when gas distribution at the inlet is more uniform, collection efficiency is higher.
- Smaller precipitator—for a given collection efficiency, precipitator size can be reduced by improving gas distribution at the inlet.
- Less pressure drop—by minimizing turbulence through improved flue design, pressure drop has been reduced by more than 40% in some cases.
- Less space needed—simplified flue arrangements and smaller precipitators can mean substantial savings in space.

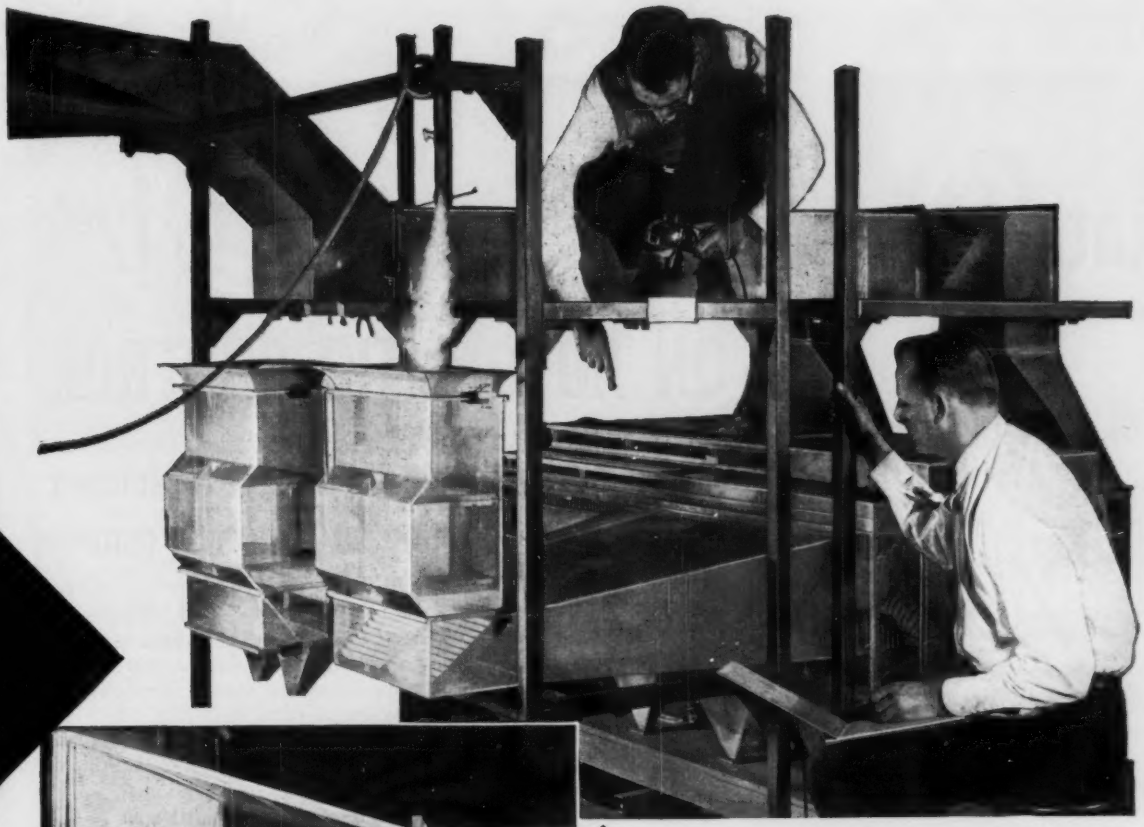


This new service is available under three broad plans:

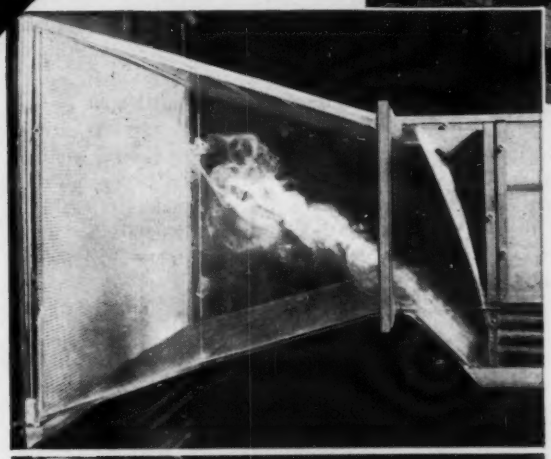
1. As part of a precipitator contract. 2. A study completely independent of a precipitator contract. 3. For any industrial gas distribution problem where these techniques will be beneficial.

For more details on this new service write for Bulletin 1.

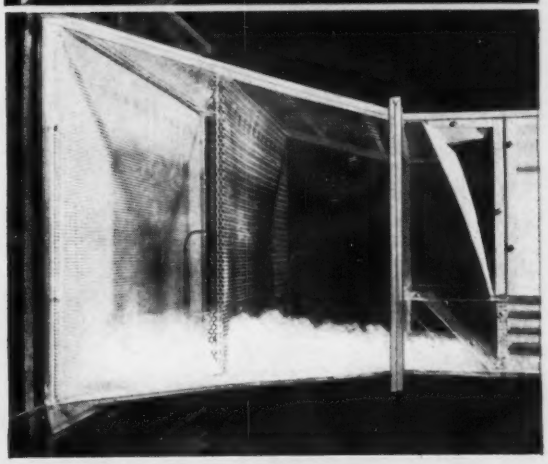
RC 186



↑ Research-Cottrell engineers studying the results of a change in flue design. This is a scale pre-installation model of a precipitator which handles 1.4 million cfm.



← The original flue design between air heater (right) and Cottrell precipitator (left) resulted in a turbulent, uneven pattern. Note the space between gas flow and bottom of flue and precipitator inlet.



← After sharp angle of flue was eliminated and perforated plate correctly positioned in flue, turbulence was minimized and gas flow hugs the floor.

A velocity traverse is being made across precipitator plates. This is part of a study on the effect of variations in positions of perforated plates in the gas handling system.

Research-Cottrell

RESEARCH-COTTRELL, INC. Main Office and Plant: Bound Brook, N. J. • 405 Lexington Ave., New York 17, N. Y. • Grant Building, Pittsburgh 19, Pa. • 228 N. La Salle St., Chicago 1, Ill. • 58 Sutter Street, San Francisco 4, Calif. • Research-Cottrell (Canada) Ltd., 33 Bloor Street East, Toronto 5, Ontario.

Station Load changes from 100% to 12%

...ON AUTOMATIC CONTROL

Hagan Automatic Systems help keep Niagara Mohawk Albany Station on frequency control

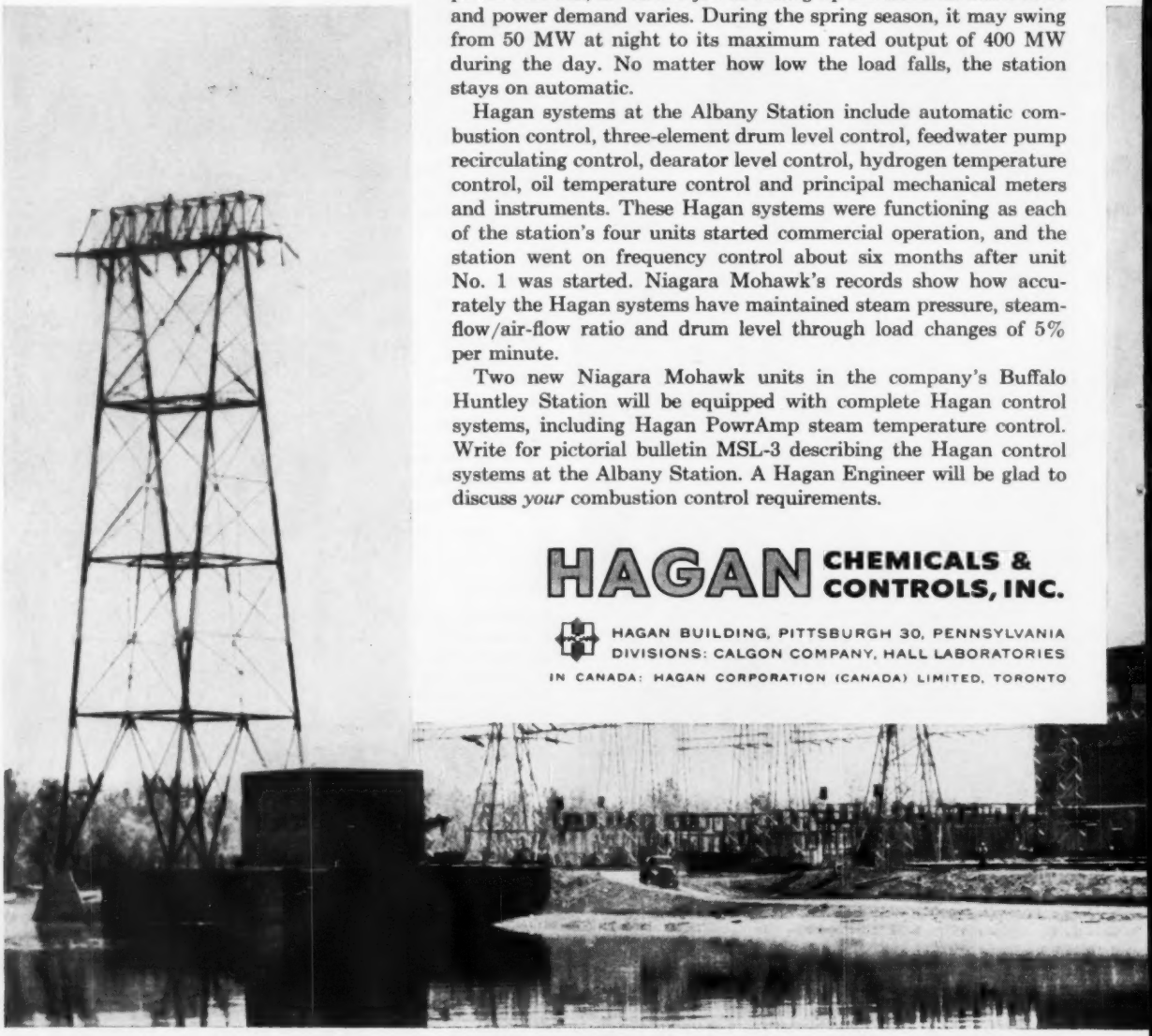
A new station seldom encounters as drastic load changes as Niagara Mohawk's Albany Station. At the end of a chain of water power stations, it has the job of taking up the slack as water level and power demand varies. During the spring season, it may swing from 50 MW at night to its maximum rated output of 400 MW during the day. No matter how low the load falls, the station stays on automatic.

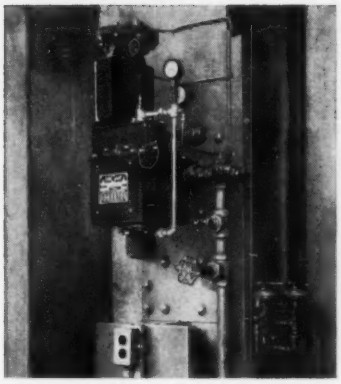
Hagan systems at the Albany Station include automatic combustion control, three-element drum level control, feedwater pump recirculating control, dearator level control, hydrogen temperature control, oil temperature control and principal mechanical meters and instruments. These Hagan systems were functioning as each of the station's four units started commercial operation, and the station went on frequency control about six months after unit No. 1 was started. Niagara Mohawk's records show how accurately the Hagan systems have maintained steam pressure, steam-flow/air-flow ratio and drum level through load changes of 5% per minute.

Two new Niagara Mohawk units in the company's Buffalo Huntley Station will be equipped with complete Hagan control systems, including Hagan PowrAmp steam temperature control. Write for pictorial bulletin MSL-3 describing the Hagan control systems at the Albany Station. A Hagan Engineer will be glad to discuss *your* combustion control requirements.

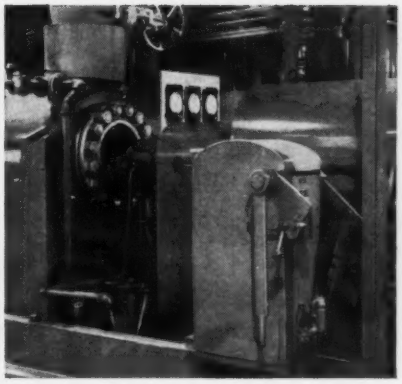
HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

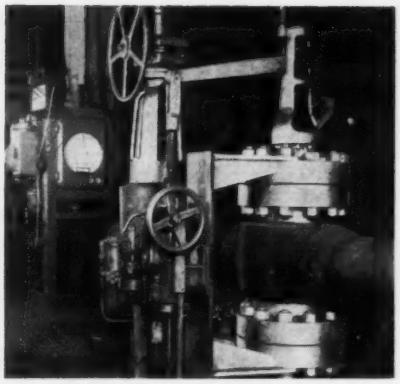




Hagan Furnace Pressure Regulator. This installation is equipped with the Hagan remote switching system, eliminating the lag normally present in long-line pneumatic systems. Controlling the Forced Draft Fan inlets, this Hagan Regulator is a unique instrument. Instant response, high stability and wide range adjustment makes the Hagan Regulator easy to tailor to a specific application.



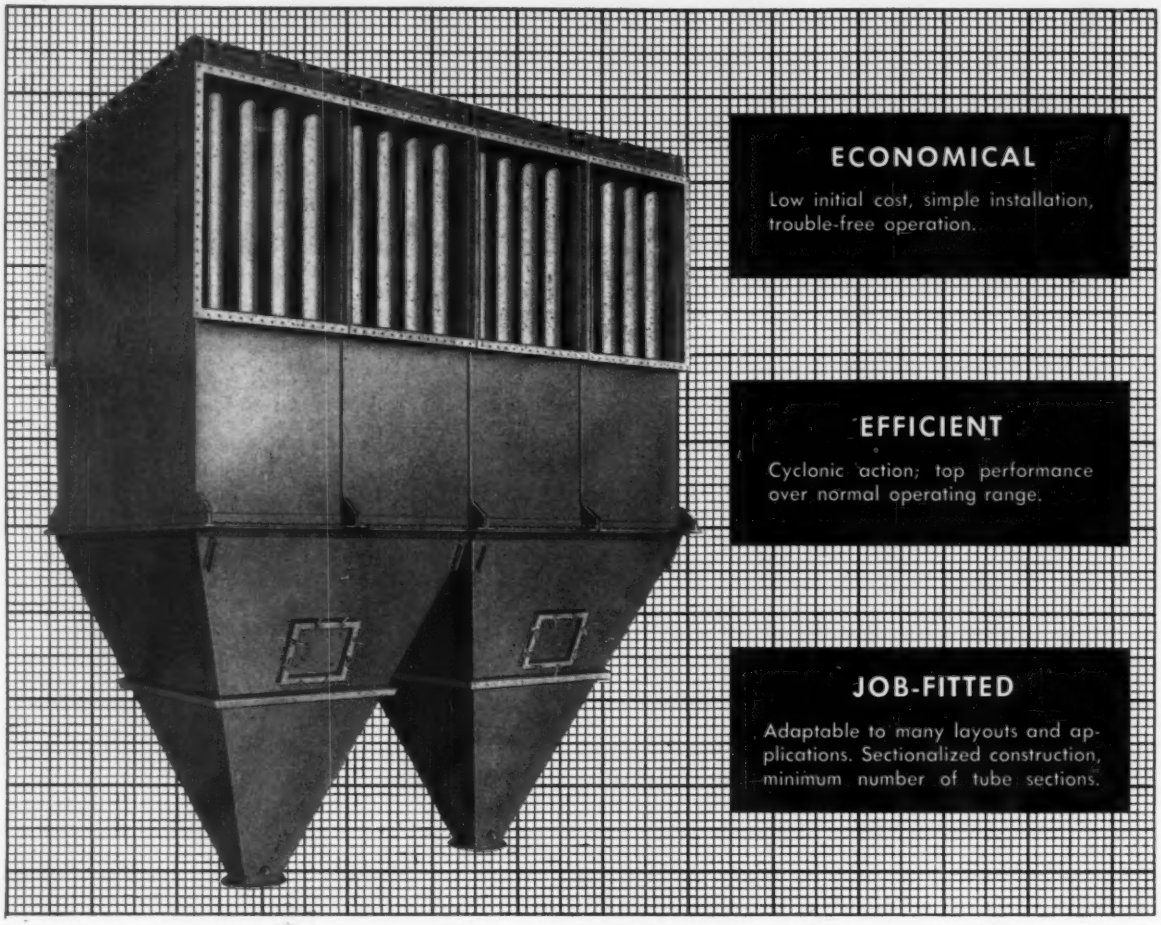
Boiler Feed Pump Hydraulic Coupling Control. Here a 6 x 10 Hagan Power Positioner implements the signal from the feed water control. This Power Positioner is one of a full range of sizes suitable for many positioning applications. Hagan Power Positioners are fast and accurate, with dependable repeatability. The panel in the background contains Hagan Ring Balance meters which record the three separate flows, totalize each flow and record the total of all three.



This 5 x 10 Hagan Power Positioner positions the feedwater control valve. Normally on standby, this valve is an alternate means of feedwater control. The Hagan Ring Balance Meter in the background transmits boiler drum water level, compensated for changes in density. This provides reliable and accurate drum level reading from atmospheric pressure to full operating pressure when going on or off the line. For details on this unique system, ask for Bulletin MSA-117.

For more facts circle 793 on Reader Service Card p 222

AMERICAN BLOWER PRECIPITATORS


ECONOMICAL
Low initial cost, simple installation, trouble-free operation.
EFFICIENT
Cyclonic action; top performance over normal operating range.
JOB-FITTED
Adaptable to many layouts and applications. Sectionalized construction, minimum number of tube sections.

Look into mechanical-type collecting equipment for control of dust and fly ash. You'll find that American Blower's Series 342 Precipitator offers three very practical advantages: adaptability, efficiency, and low cost.

Its sectionalized construction shortens erection time; factory-assembled tube sections are shipped to you match-marked for easy reassembly. And since each tube assembly is basically an individual cyclone or dust collector, the multi-tube Series 342 delivers an over-all performance comparable to the high efficiency of a small-diameter cyclone collector.

For your specific efficiency and pressure-drop requirements, a variety of tube designs and arrangements are available – in either steel or cast-iron. You may choose top, slant, or back outlet. (Front inlet is standard.)

All units feature readily removable inlet and outlet tubes to facilitate servicing; back-outlet construction has easily removed top covers. Access door on each hopper permits quick inspection.

Why not discuss your dust-collection problem with an American Blower sales engineer? He offers a complete line of fly ash precipitators and dust collectors for public utilities and industrial plants – and his application experience may prove most helpful to you. Call your nearby American Blower branch office, today. Or write: American-Standard,* American Blower Division, Detroit 32, Mich. In Canada: Canadian Sirocco products, Windsor, Ont.

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

American-Standard Products

AMERICAN-Standard

AMERICAN BLOWER DIVISION

For more facts circle 794 on Reader Service Card p 222

For more facts circle 795 on Reader Service Card p 222

FLEXIBLE METALLIC
Style: 811 Ring, Spiral

Flexible; formed from folded and crimped metal ribbons; interstices filled with graphite and mineral oil lubricant; for use on oil, water and gasoline; temperatures to 450° F.

ALL ALUMINUM
Style: 861 Ring, Spiral

Soft, annealed aluminum foil, no fabric core; for use as end rings at temperatures to 1000° F.; for rods of not less than 500 Brinnell hardness.

BRAIDED COPPER
Styles: 199 (Ring)
299 (Spiral)
399 (Coil)

Soft annealed copper wire, tightly braided in square or plaited form; for use at high temperatures, on rods of engines, and plungers of hot oil pumps; requires slight lubrication.

ANCHOR 851-TT

Styles: 851-TT Die Formed Rings, Coils. Long fiber asbestos yarn, armored with low-frictional metal, lubricated. Features resiliency, flexibility; temperatures to 450° F.

ANCHOR METALLIC PACKINGS
safeguard the life of moving parts

Among other important advantages, Anchor metallic packings combine high packing efficiency with *lowest possible friction to moving parts.* As a result, Anchor metallic packings last longer than other types. What an ideal way, then, to extend the life of rods, shafts or plungers that are running in true alignment free from wear or scoring.

Anchor metallic packings effectively seal against water, oil, air, steam and hot gases at temperatures up to 1000° F. and pressures to 1000 PSI. Many types are available in lead, copper and aluminum for use on iron, steel, Monel metal and hard bronze parts. Their use on soft metal parts usually requires lubrication.

The Anchor Packing Company—with more than 50 years experience in the mechanical packing industry—specializes in designing the packing for the application. If you have a packing problem, consult your local Anchor Representative. He will gladly help you. Or, contact the Anchor General office in Philadelphia. For information on the many Anchor products, write for our catalog.

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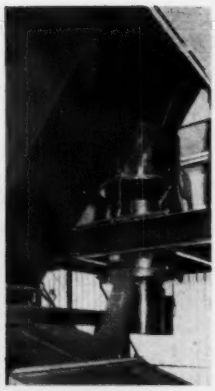
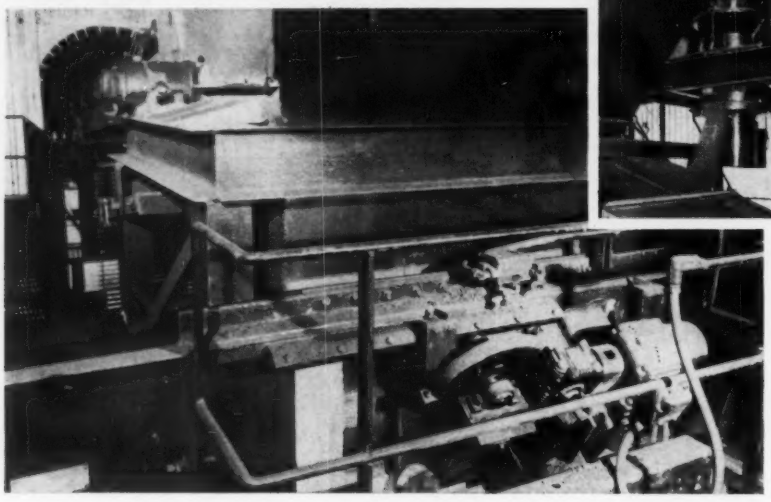
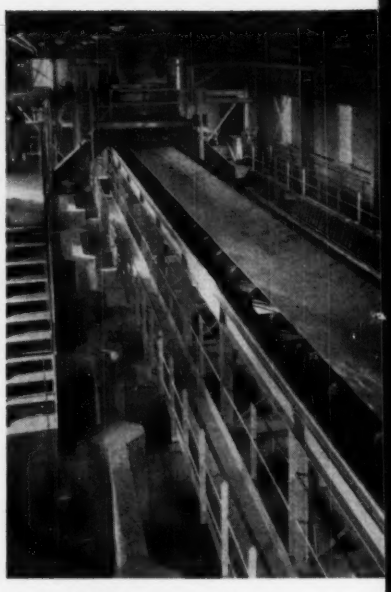
Thorsten Sampling Crusher



Thorsten Automatic Reciprocating Coal Sampler





Typical Belt Conveyor, Tripper and Bin Installation

HEYL & PATTERSON POWER HOUSE

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THEY BEAR THE MARK OF QUALITY —based on over 70 years of experience

H & P's reputation for building reliable and efficient bulk material handling equipment has been recognized by a host of consulting engineering firms who have placed their trust in our ability to serve their clients well. It is especially gratifying that we have been privileged with repeat orders. Some of our recent installations have been built in cooperation with these leading Consultants:

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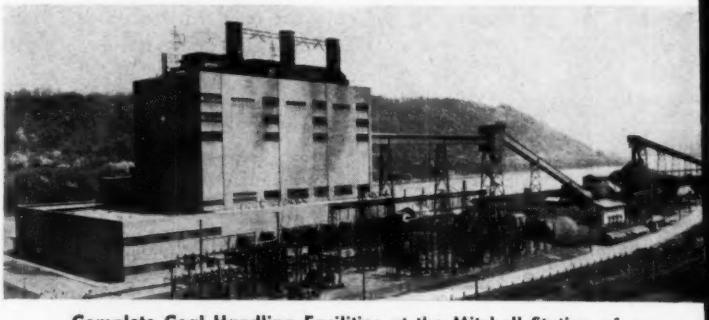
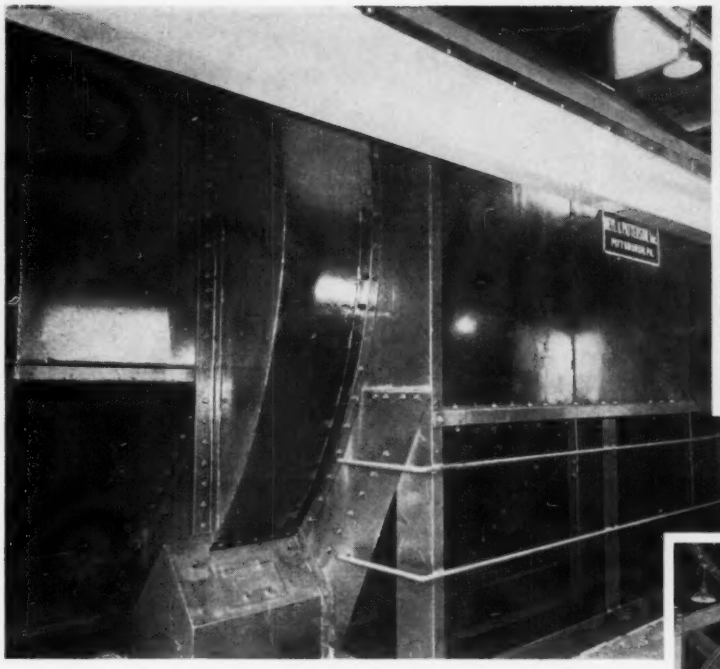
Burns & Roe, Inc.
Ebasco Services, Inc.
Gibbs & Hill, Inc.
Gilbert Associates, Inc.
Sanderson & Porter
Sargent & Lundy, Engineers
Stone & Webster Engineering Corp.

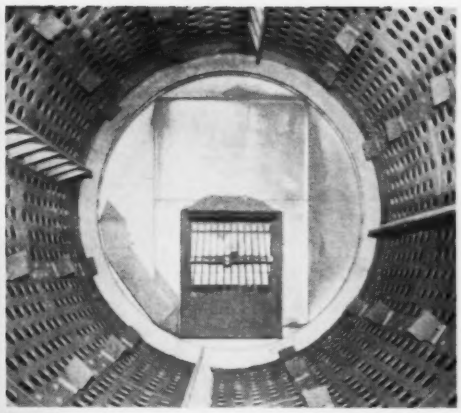
Barge Unloading Facilities of Jersey Central Power & Light Company, Raritan River Plant. Consultants: Burns & Roe, Inc.

River Unloading Station of the Public Service Company of Indiana—New Albany, Indiana. Consultants: Sargent & Lundy



Complete Coal Handling Facilities at the Mitchell Station of West Penn Power Company. Consultants: Sanderson & Porter

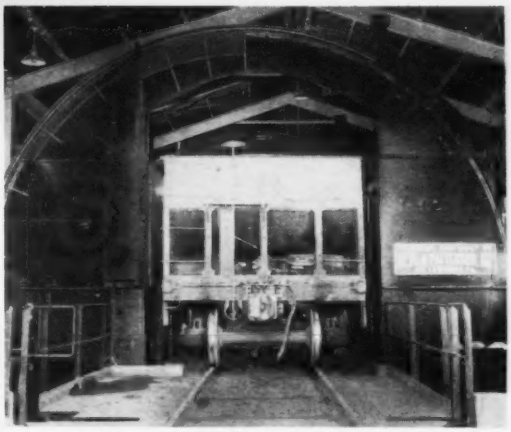




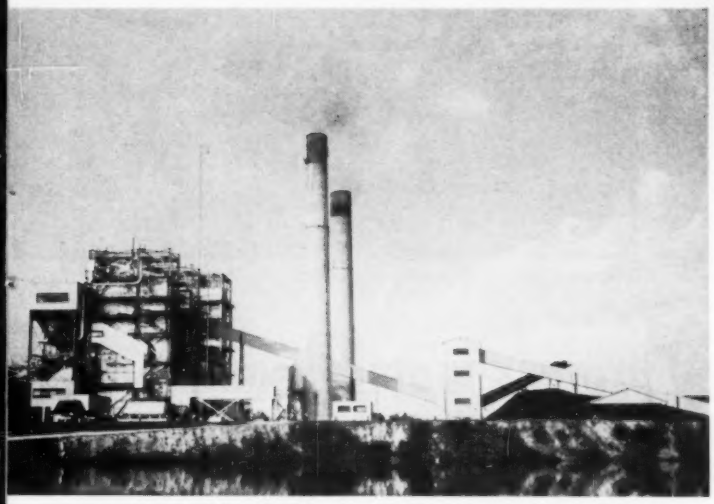
Interior of Bradford Coal Breaker

Bradford Coal Breaker for scalping and upgrading coal

COAL HANDLING



H & P Rotary Railroad Car Dumper, similar to installation at Metropolitan Edison Company, Portland Station. Consultants: Gilbert Associates, Inc.



Complete Coal Handling System for Carolina Power & Light Company's Lumberton Station. Engineers & Constructors: Ebasco Services, Inc.

H & P provides you with a single source—**Complete Power House Coal Handling** or component parts such as:

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Kinney Car Unloaders (for frozen coal)
Lowering Wells
Rotary Car Dumpers
Specialized Conveying Systems
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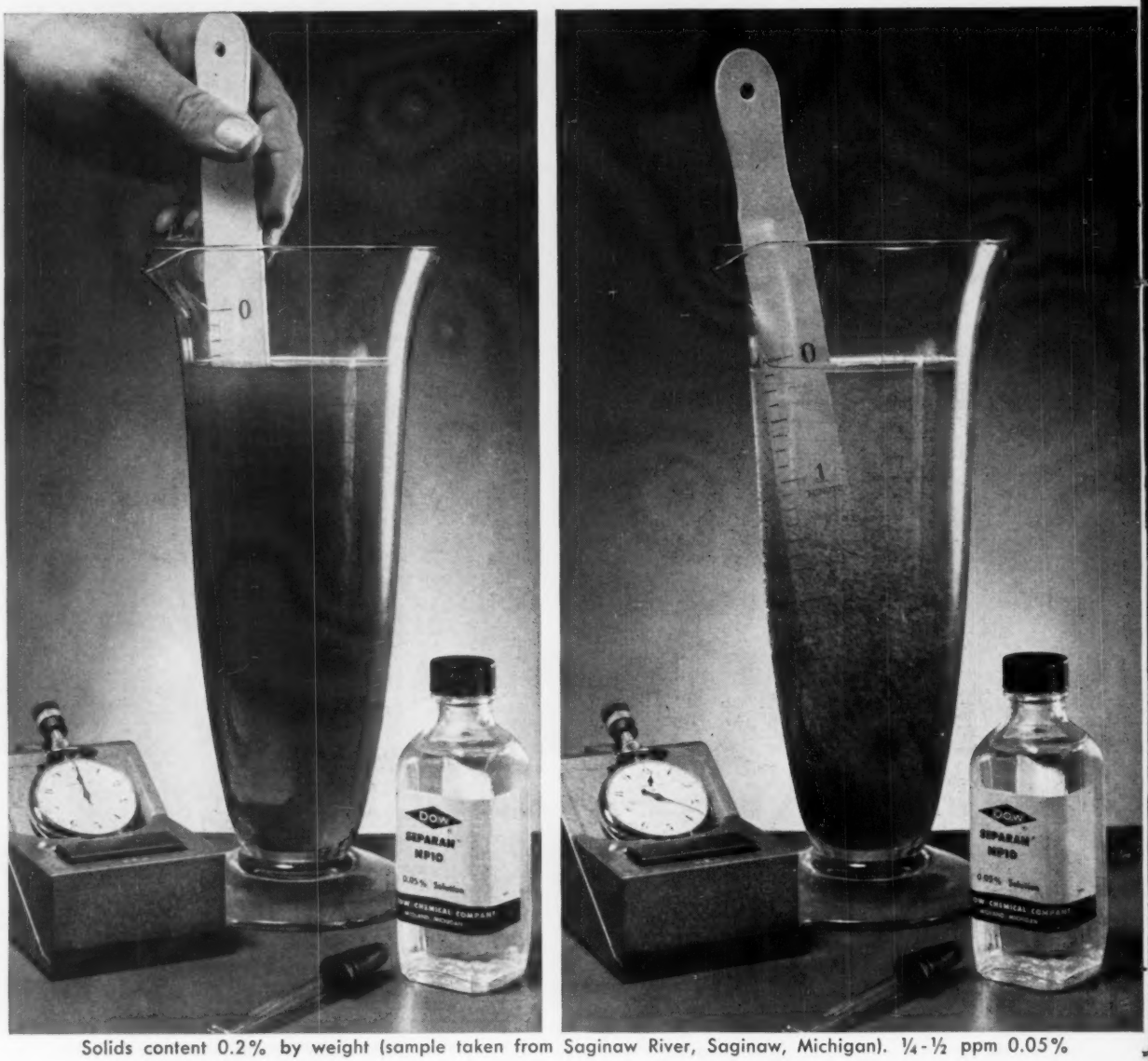


Solids content 0.2% by weight (sample taken from Saginaw River, Saginaw, Michigan). ¼-½ ppm 0.05%

Separan flocculants speed process water throughput . . .

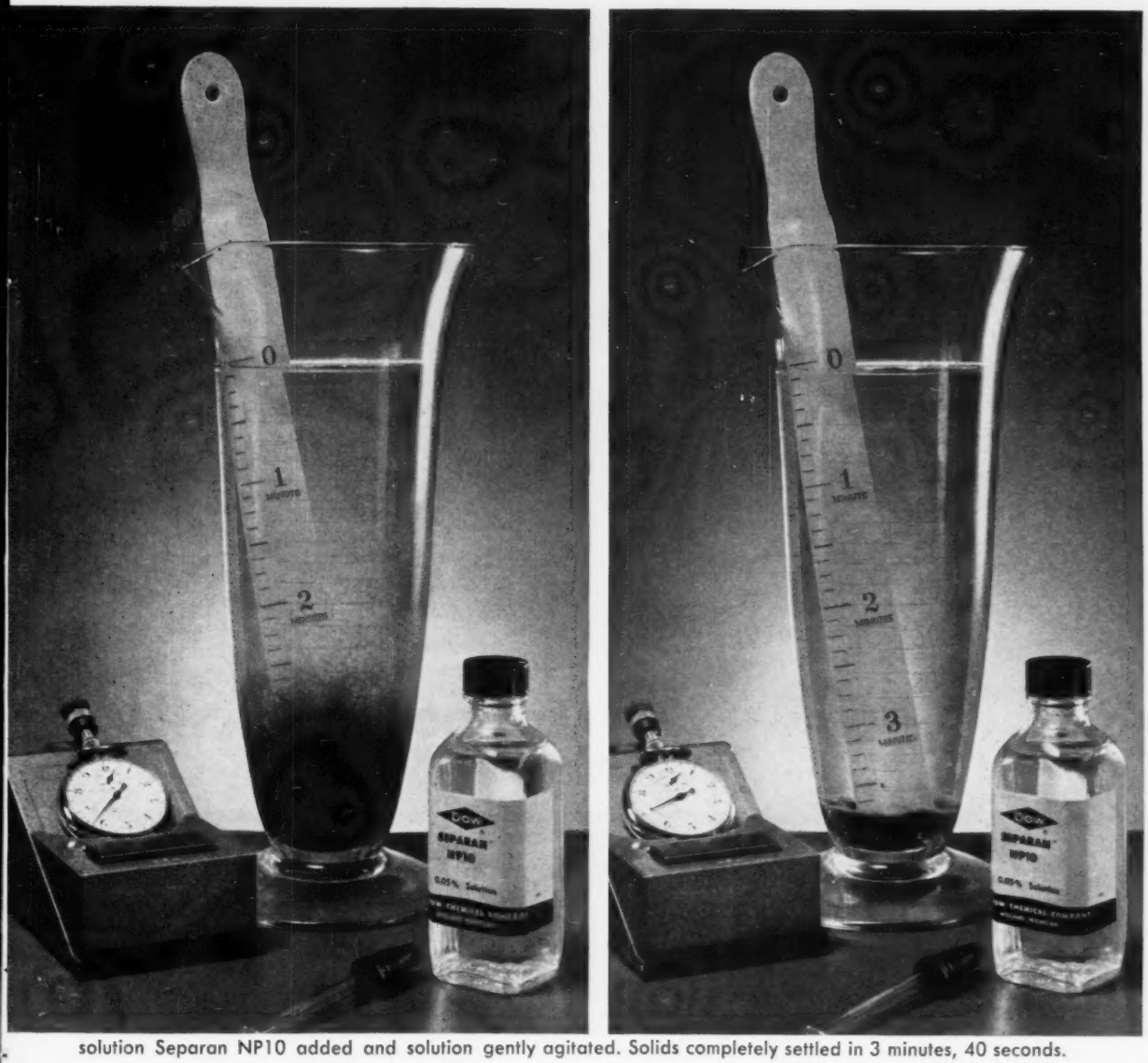
Dow's new high-powered flocculating agents, Separan® NP10 and NP20, are used by many engineers to clarify water for processing or cooling purposes—in a fraction of the time required with other flocculants!

Two particular characteristics make Separan flocculants very valuable. First, the speed with which they act. Second, the quality of the floc formed.

These properties speed sedimentation, filtration, clarification, softening and recovery operations under a wide range of pH conditions. No special equipment is needed. Separan flocculants are added to other flocculants (e.g. alum, ferric chloride) to enable the settling job to be accomplished in a fraction of the time normally required. Separan flocculants are synthetic, organic products—easy to disperse, easy and safe to use, noncorrosive. They are effective over a wide temperature range, require no heat or preservative.

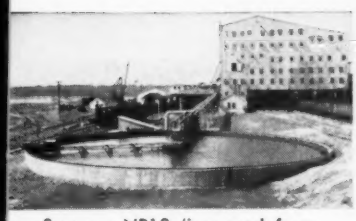
Dow Stressing Flocculant Research. Separan NP10 (improved form of Separan 2610) and Separan NP20 may soon be joined by other new flocculants for specific uses.

Dow can help you trim your water treatment costs with flocculating agents, ion exchange resins and chelating agents. Contact your nearest Dow sales office for detailed information. Quantities of Separan flocculants are immediately available for your own testing and evaluation. THE DOW CHEMICAL COMPANY, Midland, Michigan, Engineering Chemicals Department 1057E-1.



solution Separan NP10 added and solution gently agitated. Solids completely settled in 3 minutes, 40 seconds.

without adding equipment!



Separan NP10 (improved form of Separan 2610) offers greater clarity, higher purity and easier dispersibility!

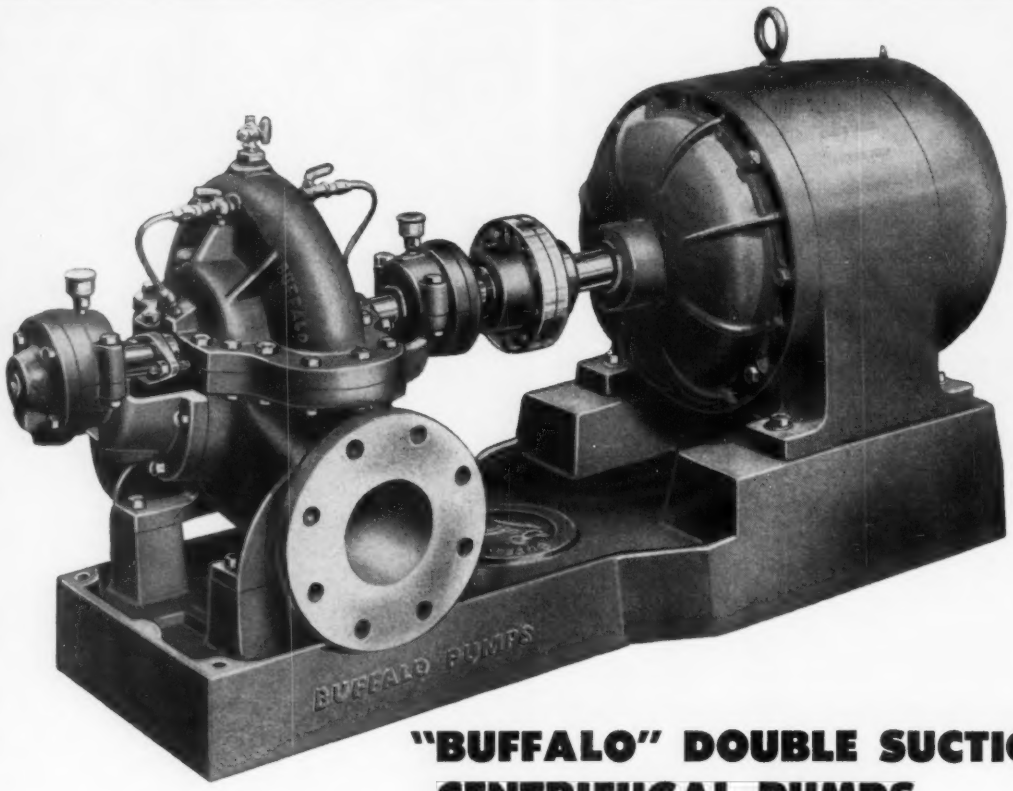
Increased production in most types of water processing operations can be accomplished with a Separan flocculant—without extra capital investment!

YOU CAN DEPEND ON DOW

REPORTS OF SUCCESSFUL USE OF SEPARAN NP10 IN PROCESS WATER TREATMENT

Location	Water Source	Separan NP10 Used	Results
East	river	½ ppm added last to chemical mix & coagulation tank	Improved clarity, reduced color, increased capacity
Ontario	river, high in clay	½ ppm added to clarifier, alum added in preceding tank	Improved clarity, reduced alum, elimination of silica
Far West	river, low in suspended & dissolved solids	0.1 ppm added after clarifier just before filters	Improved clarity & filter operation, elimination of silica
Southwest	brine, high in Ca.	0.15 ppm added to secondary mixing zone of clarifier	Improved clarity, increased throughput, reduced lime & $Fe_2(SO_4)_3$
Midwest	well water, hard	¼ ppm added to softener, lime and $NaAlO_2$ added in preceding tank	Reduced turbidity, less $NaAlO_2$, more stable against post-precipitation of $CaCO_3$
Southeast	river water, colored, turbid	¼ ppm added to clarifier, alum & lime added in preceding tank	Improved clarity, reduced color

For more facts circle 797 on Reader Service Card p 222



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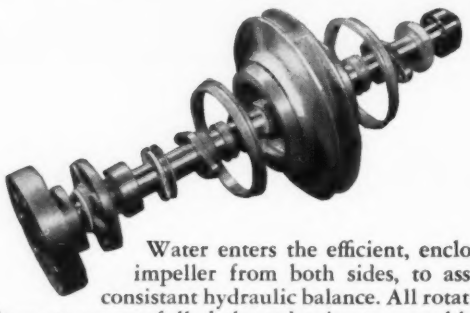
"Buffalo" Pumps' engineering and rugged, dependable construction make them highly desirable for demanding industrial service. For example, "Buffalo" Double Suction Pumps for dependable clear water service feature precision-machined casings with ample water passages — impellers designed for highest efficiencies — bronze wearing rings — sturdy shafts and heavy-duty ball bearings.

The complete line of "Buffalo" Double Suction Pumps, in capacities from 10 to 14,000 gpm, assures the pump that's tailored to *your* clear water moving needs — *exactly*. For full information, contact your nearby "Buffalo" Engineering Representative, or write for Bulletin 955-R.

Value Beneath the Surface . . . the impeller and shaft assembly of the "Buffalo" Double Suction Pump.



Water enters the efficient, enclosed impeller from both sides, to assure consistant hydraulic balance. All rotating elements are carefully-balanced prior to assembly.

The value "bonus" in every "Buffalo" Pump is the "Q" Factor — the built-in QUALITY which assures trouble-free satisfaction and long life.

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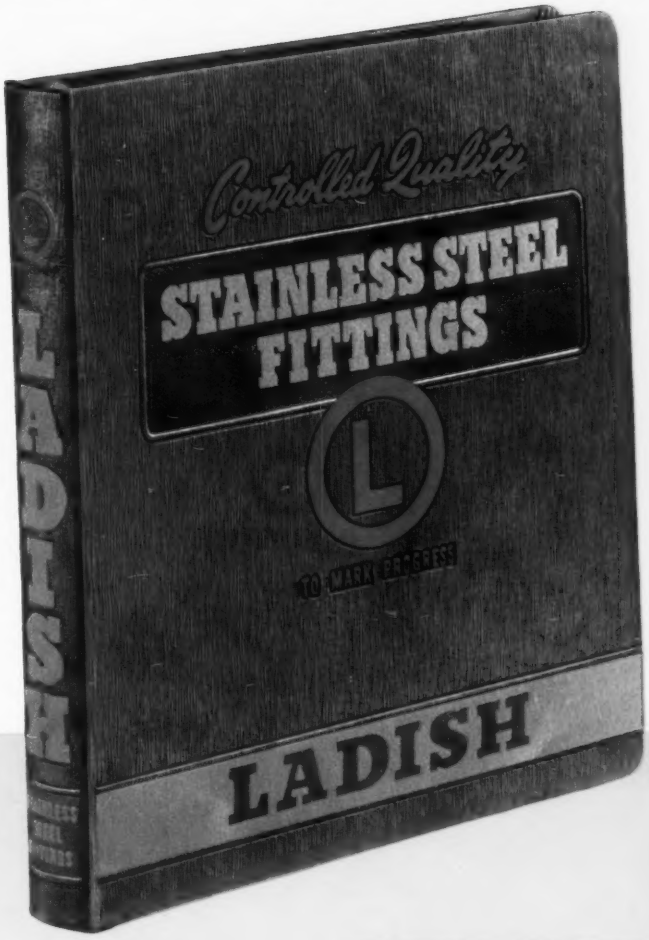

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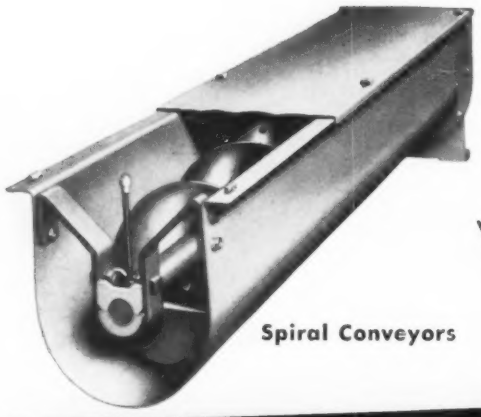
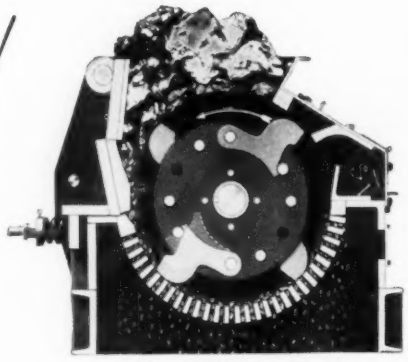
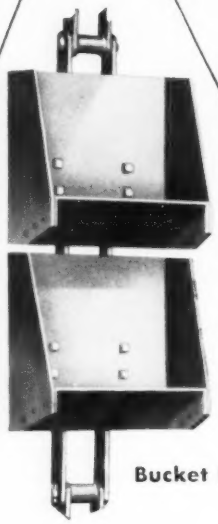


Spiral Conveyors

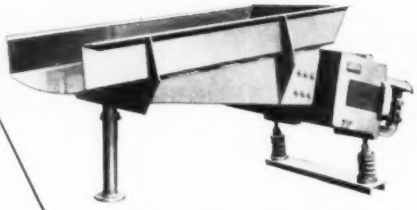


Flextooth Crushers

Scraper Conveyors



Bucket Elevators



Electric Vibrating Feeders

JEFFREY DEPENDABILITY counts most in equipping and cperating a power plant

A high standard of design, materials and workmanship has made Jeffrey coal and ashes handling equipment the choice of leading power plant engineers. Whether you're planning a complete plant or revamping an old one, consider these Jeffrey products—

Spiral Conveyors for distributing coal to bunkers and hoppers are ideal where space is limited and capacity demands are not high. Coal can be discharged at any point by means of valves in trough bottoms. Available in various standard lengths.

Flextooth Crushers reduce lump coal to uniform sizes in a single operation, assuring maximum efficiency for mechanical stokers. An adjustable breaker plate permits making a wide range of sizes.

Electric Vibrating Feeders regulate flow to belts, elevators, pulverizers, weigh hoppers, etc., drawing feed from track hoppers and storage bins. Operate on the level, up or down grade. Impart no vibration to supporting structures. Capacities up to 600 tons per hour.

Bucket Elevators provide continuous handling of coal and ashes at low cost and require a minimum of space. Jeffrey furnishes elevators in various heights and in capacities of 25 to 40 tons per hour. Certain types can be employed for elevating and also for distributing coal to bunkers.

The Scraper Conveyor is one of the simplest of conveying units. Flights of various shapes, attached to either single or double strands of chain, drag the material in a steel trough. Operation may be horizontal or on an incline.

Detailed information on Jeffrey equipment for power plants is available upon request. The Jeffrey Manufacturing Company, Columbus 16, Ohio.

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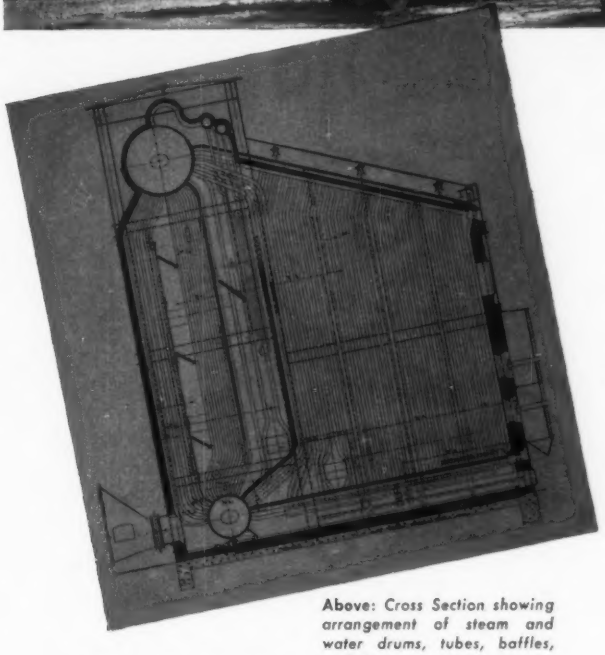
Viola, Texas



Above: *Cross Section showing arrangement of steam and water drums, tubes, baffles, and furnace.*

EFFICIENCY AND ECONOMY PROVED BY FIRST 3 UNITS . . . 2 MORE ADDED!

Principle Data Each Unit

- 85,000 pounds steam per hour capacity, designed for 500 lbs. S.W.P. and 625° F. total temperature.
- Water cooled furnace.
- Burners for Gas and Oil fuel.

Vogt offers a complete line of custom built and package type steam generators. Available in bent tube and straight tube designs for solid, liquid, or gaseous fuels burned singly or in combination.

Write for bulletins. Dept. 24A-BP

OTHER VOGT PRODUCTS

Drop Forged Steel Valves, Fittings and Flanges—
Petroleum Refinery and Chemical Plant Equipment
Heat Exchangers
Ice Making and Refrigerating Equipment

HENRY VOGT MACHINE CO.
Box 1918, Louisville 1, Kentucky

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Philadelphia, St. Louis, Charleston, W. Va., Cincinnati

Caterpillar

makes tracks for coal

Seven Caterpillar Tractor Co. plants burn coal for low-cost steam generation

When seven plants of a company all burn coal—over 250,000 tons a year—you can be sure there's a *good* reason. At Caterpillar Tractor Co., where steam is used for both process work and heating, coal is burned for low-cost, efficient steam production.

Because of its importance at Caterpillar, steam generation must meet the same standards of efficiency and dependability set up for all phases of plant production. As Caterpillar has expanded from one plant to many, therefore, *each* plant has burned coal.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

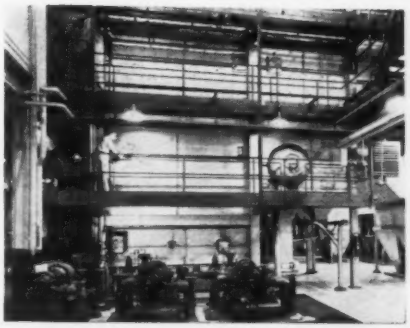
To help you with industrial fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send coupon below for our case histories booklet, complete with data sheets. You'll find it informative.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

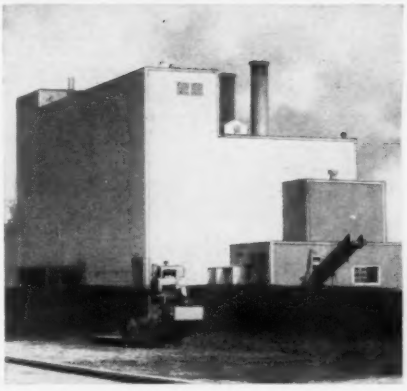
BITUMINOUS COAL INSTITUTE

Department P-10,
Southern Building • Washington 5, D. C.



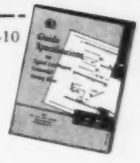
Power house at Morton, Ill. plant uses two 60,000 lb/hr Wickes boilers, 3 stories high. These are equipped with Hoffman continuous ash-discharge spreader stokers.

Track unloading hopper at York plant. Coal feeds from belt conveyor to bucket conveyor to distributing flight conveyor over storage bunker. Coal handling system by Beaumont Birch.



Exterior view of power plant at Joliet, Ill. Foreground shows part of outside coal storage area featuring portable car unloader and stacker. Coal is stocked out and reclaimed by Caterpillar bulldozer-equipped crawler tractor.

SEND COUPON FOR *NEW* "Guide Specifications for Underfeed Stoker Fired Low-Pressure Commercial Heating Plants." Heavy demand for the first edition of this booklet, adaptable for design loads 3,000 to 26,000 EDR steam, has justified an expanded edition covering application of underfeed stokers to firetube, watertube and section cast iron boilers. Complete specification criteria cover all aspects of typical heating plant. P-10



☐ Guide Specifications booklet ☐ Case histories on larger plants

Name_____

Title_____

Company_____

Address_____

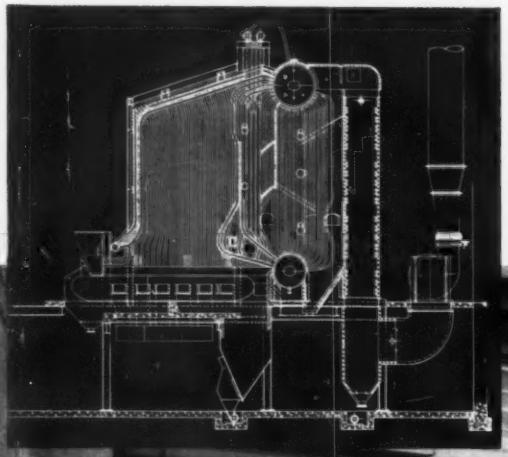
City_____ Zone____ State_____

For more facts circle 802 on Reader Service Card p 222

EFFICIENCY REPORT:

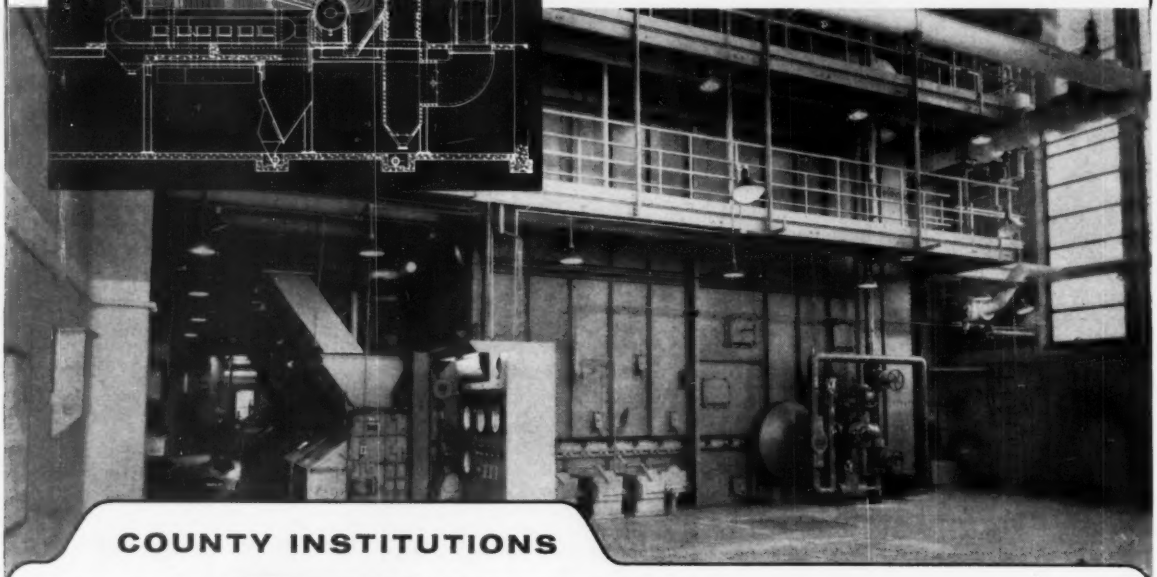
5 Union Boiler installations score top ratings

STATE HOSPITAL

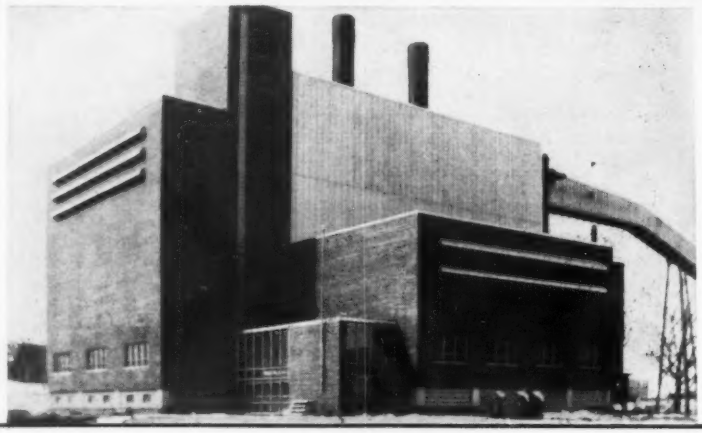


Uninterrupted Low Cost Steam Service

On duty at Mendota State Hospital, Madison, Wisc., this pair of Union 2-drum VO Type Boilers has proved a dependable, economical steam source. Since installation, the hospital's 40 buildings grouped on 384 acres have enjoyed an unbroken steam supply. Individually rated at 50,000 lbs./hr., both units are fired with traveling grate stokers, and together burn 12,000 tons of coal annually.



COUNTY INSTITUTIONS



86.52% Efficiency Tops Performance Guarantees

Milwaukee County Institutions — 4 hospitals, a sanatorium, children's home, administration building, and nurses' home . . . 35 million cu. ft. of building in all — rely on three Union 4-drum Type B Boilers to handle **entire steam load** for heat and power. Job-tested at an average individual output of 110,934 lbs./hr., these boilers outstripped performance guarantees with an 86.52% efficiency rating.

UNIVERSITY

Efficiency Upped from 68% to 83%

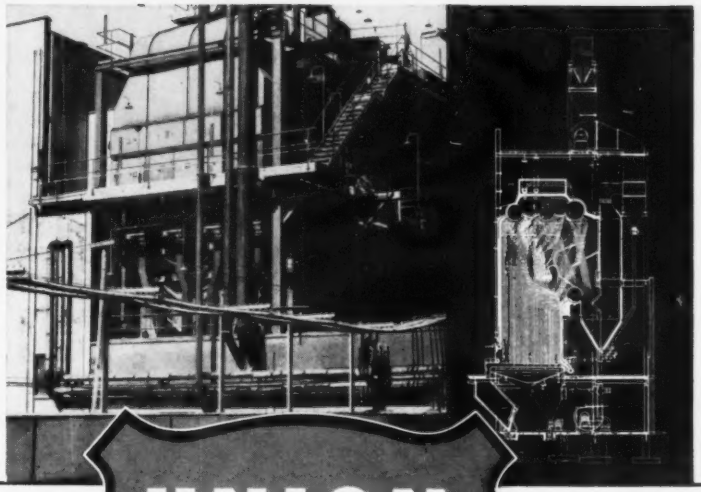
Replacing three of the original boilers, a pair of Union 2-drum VO Type Steam Generators now provides heat and power for entire Notre Dame campus — 75 buildings on 1700 acres. Rated 70,000 lbs./hr., these spreader-stoker units are equipped with superheaters and economizers. Although heating load has been increased 20%, efficiency is up from 68% to 83%.

HOSPITAL-SANATORIUM

86.46% Efficiency Helps Stretch Fuel Dollars

Long term steam costs are held to a minimum by 3 Union Type VO Steam Generators at New Jersey's Essex County Hospital. Serving 75 buildings spread over 553 acres, these 2-drum boilers posted 86.46% in efficiency tests. With unit capacities of 50,000 lbs./hr., they drive two 1000 KW generators, furnish all space heat, drive hot water circulating pumps, and supply steam for cooking, water treatment and deaeration needs.

PAPER MILL



Key Role in Power Modernization Award

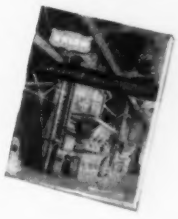
Winner of a Power Modernization Award, John Strange Paper Co. installed a Union 4-drum Steam Generator to supply steam for electrical power and processing. With capacity of 165,000 lbs./hr. at 725 psig and 825°F., this Union semi-outdoor boiler has played a key role in boosting production 10% while saving 29% in fuel costs without increasing plant personnel.

UNION

UNION IRON WORKS
ERIE, PENNSYLVANIA

LIKE MORE DETAILS?

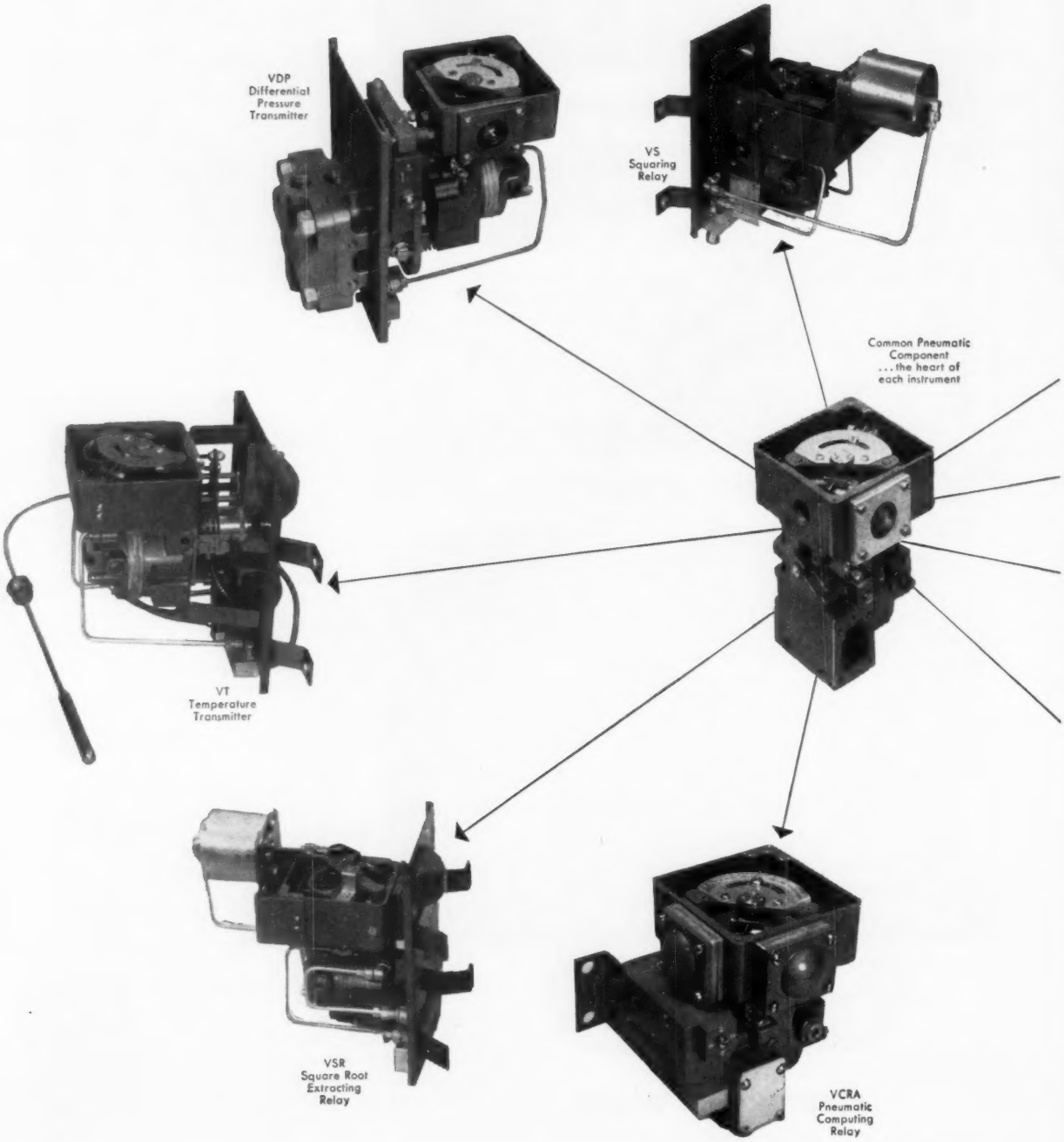
Union Steam Generators are built in many sizes and types, and can be outfitted to meet a wide range of requirements. Send for illustrated Catalog GB-958.



For more facts circle 803 on Reader Service Card p 222

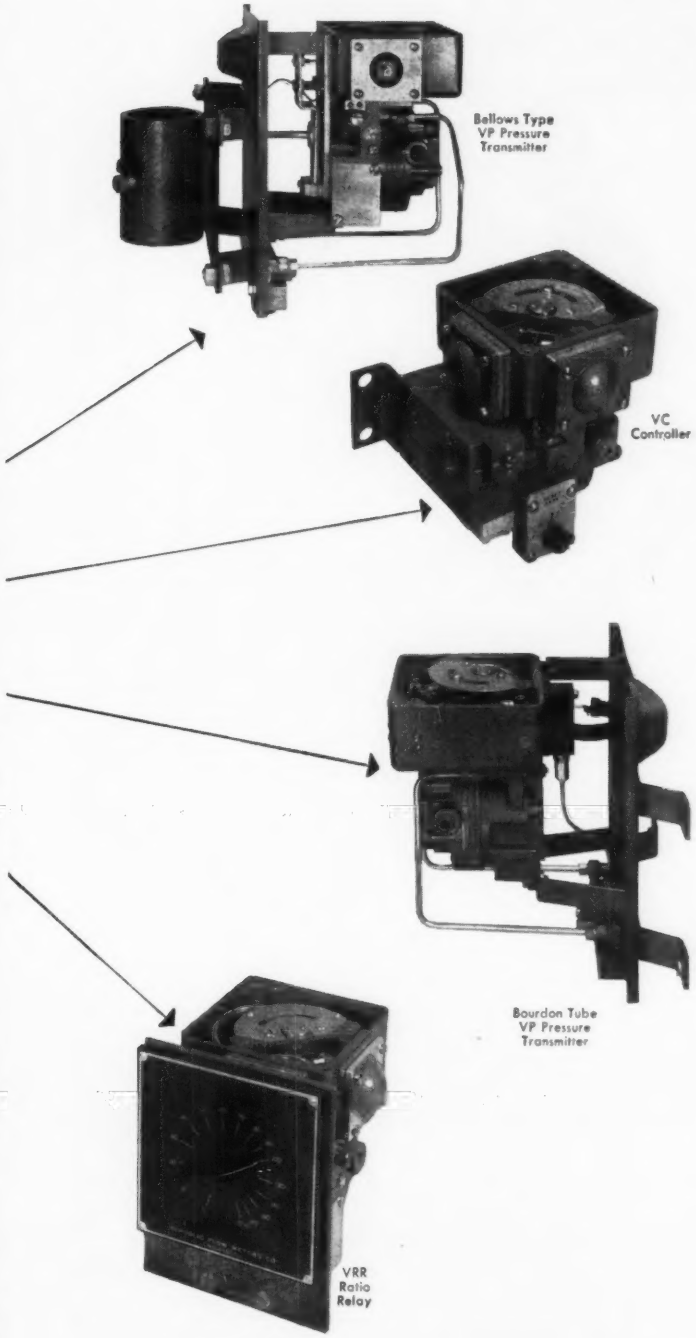
Rockwell-Built REPUBLIC

serve any process,



VECTOR SERIES INSTRUMENTS

cut costs too!



You can save substantial money when your control systems are based on Republic's Null-Balance Vector instruments. Each has as its "heart" an identical pneumatic component, with obvious advantages. Among these are interchange of parts, even among instruments performing entirely different functions. Besides involving a minimum spare parts inventory, this feature greatly simplifies personnel training.

Components shown demonstrate the depth of the Republic line. Differential pressure transmitters with 20-to-1 range adjustment . . . temperature transmitters with 10-to-1 range adjustment . . . pressure transmitters of ±0.5% accuracy. We have ratio, totalizing, multiplying, squaring and square root extracting relays. Our all-purpose controllers feature proportional band adjustment of 2% to 500% and reset adjustment from 0.1 to 50 repeats per minute.

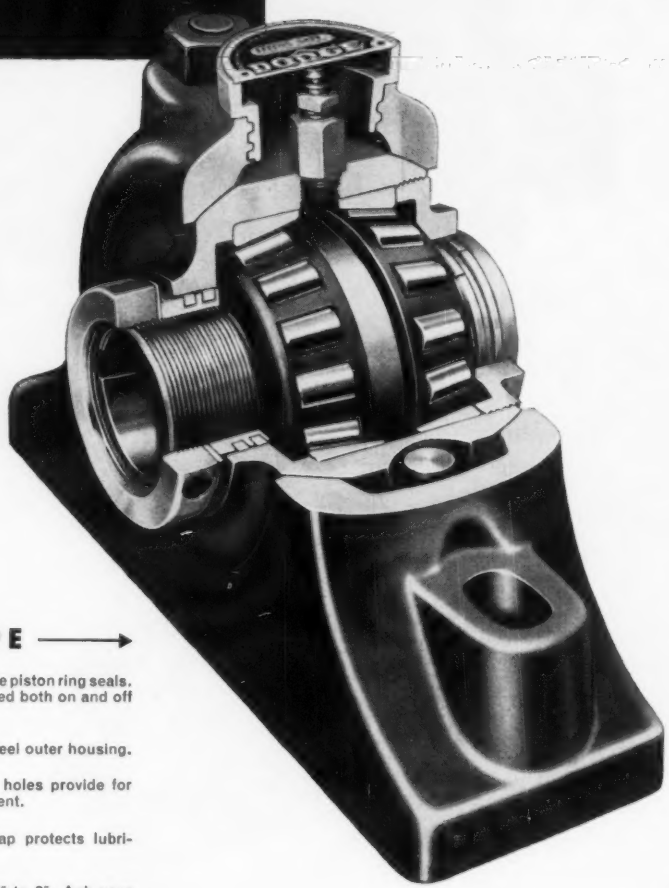
The Republic Engineer in your area will be glad to work with you on any control or measurement problem. Sales offices in principal cities throughout the United States and Canada. Call or write—with no obligation, of course—*Republic Flow Meters Company*, 2240 Diversey Parkway, Chicago 47, Illinois (subsidiary of Rockwell Manufacturing Company). In Canada: Republic Flow Meters Canada, Ltd., Toronto.

REPUBLIC INSTRUMENTS AND CONTROLS
more fine products by
ROCKWELL

DODGE PILLOW BLOCKS

Timken Bearing Equipped

America's super-quality line—with a 34-year record of keeping performance *up* and costs *down!* Five types—to fit practically any service condition. All assembled, adjusted, lubricated and *sealed* at the factory for precision performance—long life—dependability.



SPECIAL DUTY TYPE →

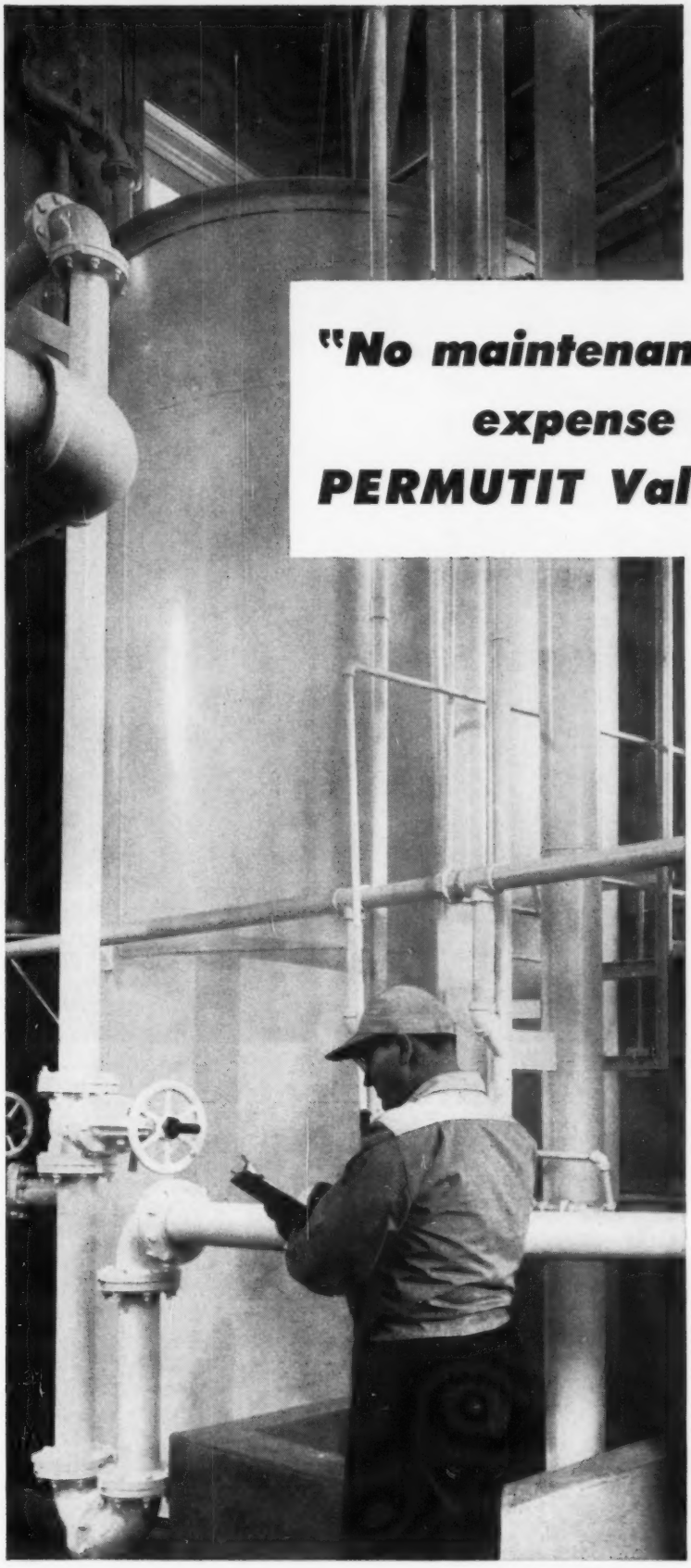
- Designed for extreme precision and high load capacities.
- Fully self-aligning.
- Special Duplex Timken Roller Bearing with tapered bore.
- Split tapered sleeve with straight cylindrical bore extends through entire length of housing.
- Easy to mount or demount. Adapter nut (or collar) clamps adapter sleeve to shaft with extreme firmness.
- Automotive type piston ring seals. Bearing is sealed both on and off the shaft.
- Rugged semisteel outer housing.
- Elongated bolt holes provide for lateral adjustment.
- Special dust cap protects lubrication fitting.
- Shaft sizes 1¾" to 8". Ask your local Dodge Distributor—or write us for Bulletin A670 giving complete technical data on America's most complete line of mounted bearings.

DODGE MANUFACTURING CORPORATION, 3200 Union St., Mishawaka, Ind.

CALL THE TRANSMISSIONEER, your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look in the *white* pages of your telephone directory for "Dodge Transmissioneer."

DODGE
of Mishawaka, Ind.

For more facts circle 805 on Reader Service Card p 222



One of two Permutit Automatic Valveless Water Filters at O. M. Scott & Sons Co. Chemical Products Plant, Marysville, Ohio. Each filter is 7' diam. and rated at 116 gpm. The complete Permutit water-treatment system was engineered by H. A. Williams and Associates, Columbus, Ohio.

"No maintenance or operating expense with our PERMUTIT Valveless Filters"

- These filters have been operating continuously for over a year and a half . . . supplying water for process, boiler feed and drinking. They follow a Permutit Precipitator that treats raw well water with lime, soda ash and coagulants. Either filter can handle full feed rate during inspection or repairs on the other.

- Here's how Glenn L. Moll, Scott's Service Manager, puts it: "Our Permutit Automatic Valveless Filters are operating very satisfactorily. The filter-bed and underdrain system stay clean with no evidence of blow holes or sifting of filter media to the underdrain system. We now inspect them only twice a year."

- The Valveless Filter is completely automatic—yet costs up to 45% *less* than conventional automatic gravity filters because it uses no expensive valves, flow controllers, pumps or hydraulic or pneumatic control systems.

Send for descriptive bulletin. Address: The Permutit Company, Dept. PO-10, 50 West 44th Street, New York 36, N.Y. or Permutit Company of Canada, Ltd., Toronto 1, Ontario.

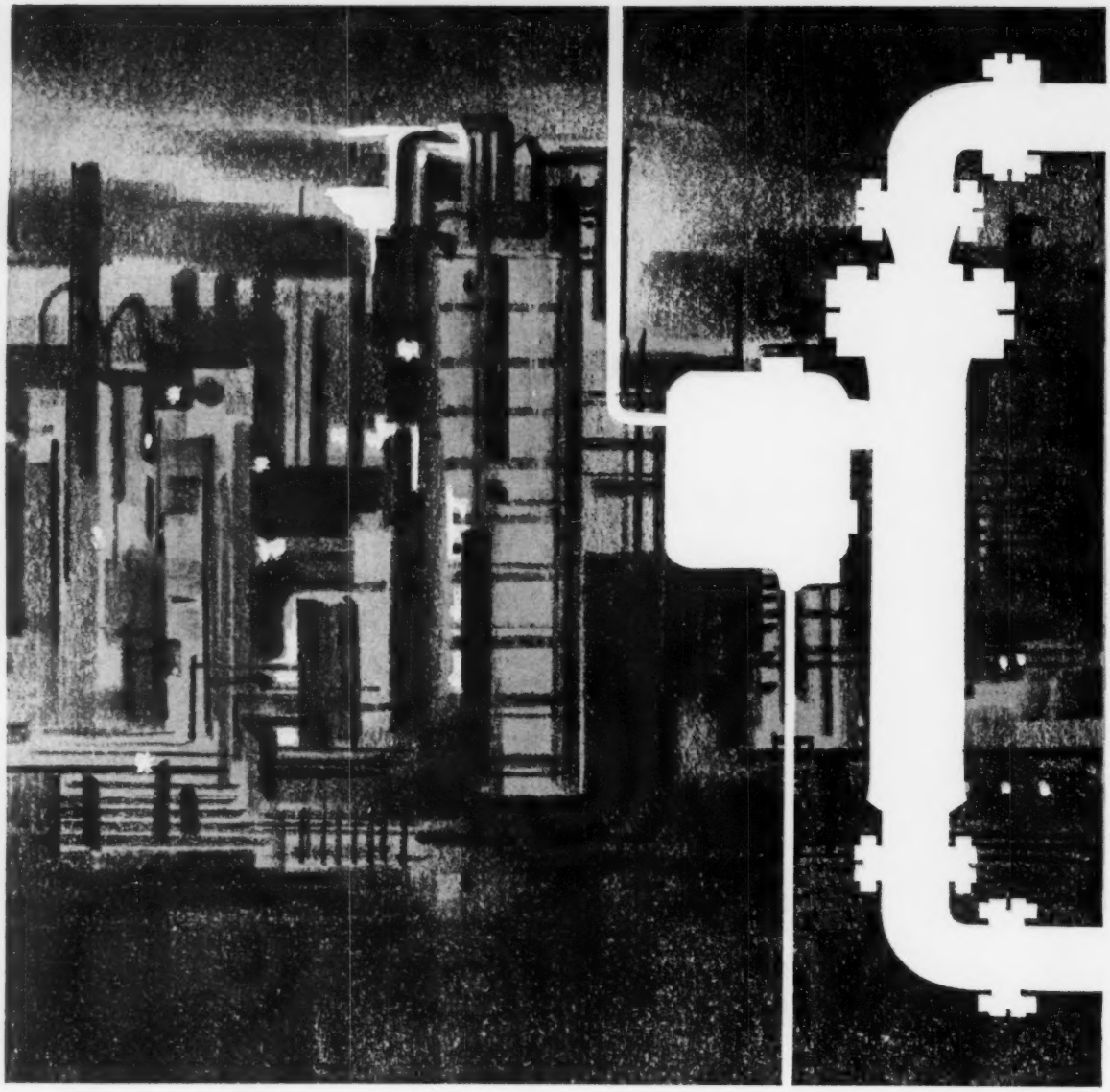
PERMUTIT®

rhymes with "compute it"

A DIVISION OF PFAUDLER PERMUTIT INC.

Water Conditioning
Ion Exchange • Industrial Waste Treatment

For more facts circle 806 on Reader Service Card p 222



Fisher Level-Trols—universally accepted in the power and process industries

High in sensitivity and accuracy! For full float range operation the Fisher Level-Trol is factory calibrated or zero adjusted to produce an accurate 3 to 15 psi or 6 to 30 psi signal output. Designed, engineered and universally accepted for most liquid level control, liquid level indication and interface control problems. Has simple liquid level adjustment indicating dial—combined pneumatic proportional band and specific gravity adjustment. Heavy-duty built—easy to operate—simple to service. Available with cage units for external mounting or internal top or side flange mounting with float sizes from 14" to 120".

Write for Bulletin F4A for full details.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...

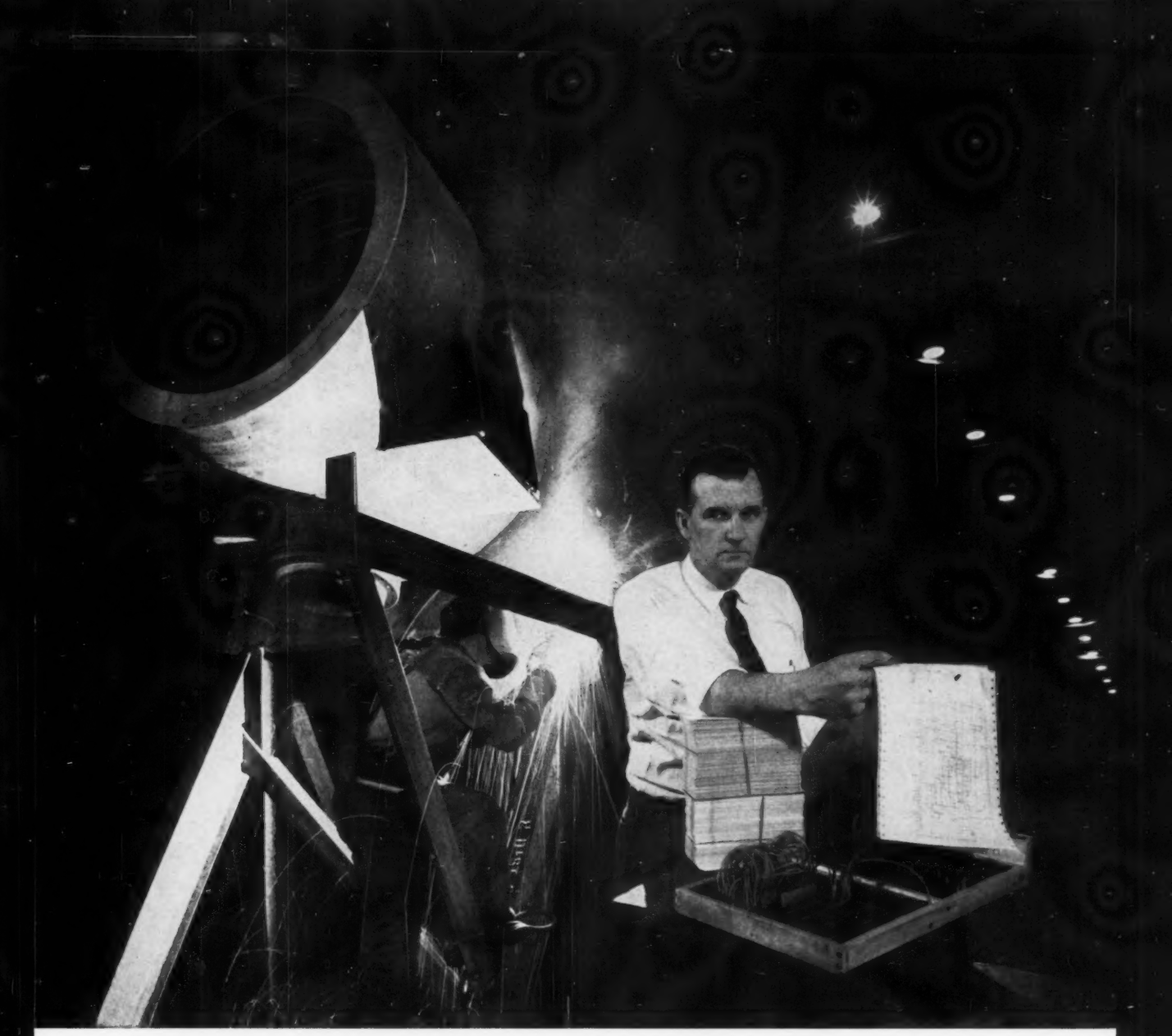
FISHER GOVERNOR COMPANY

Marshalltown, Iowa / Woodstock, Ontario / London, England

FISHER® Controls

SINCE 1880

For more facts circle 807 on Reader Service Card p 222



Automatic data processing, applied to the many variables of thermal design, results in higher efficiency of ALCO *feedwater heaters.*

HOW DO YOU FIGURE A FEEDWATER HEATER?

The trend to higher pressure and temperature in utility and industrial power plants demands *exact* design of feedwater heaters for the best heat-rate economy. ALCO, a 30-year pioneer in the heat transfer field, is again pacing the industry by focusing thermal engineering on solutions to this problem.

Advanced data on heat transfer and fluid flow from ALCO's new thermal laboratory, programmed through new electronic digital and analog computers, permits ALCO to offer the most accurate feedwater-heater thermal designs available today. Already in service and on order for the country's most efficient steam-generating plants, these heaters are proving their economy and reliability.

For more information, contact your nearest ALCO sales office or write for brochure on feedwater heaters to: ALCO Products, Inc., Dept. 132, Schenectady, New York.

ALCO

ALCO PRODUCTS, INC.

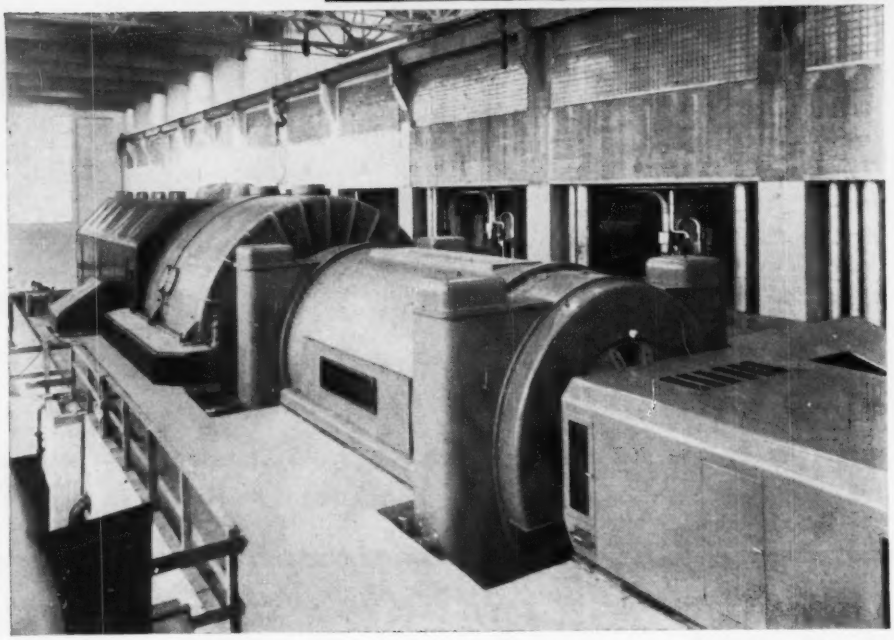
NEW YORK

SALES OFFICES IN PRINCIPAL CITIES

Locomotives · Diesel Engines · Nuclear Reactors · Heat Exchangers · Springs · Steel Pipe · Forgings · Weldments · Oil Field Equipment

For more facts circle 808 on Reader Service Card p 222

brown boveri
STEAM TURBINE GENERATOR SETS



AVAILABLE SIZES
(Complying with ASME-AIEE Preferred Standards)

11/12.65 MW
20/22 MW
30/33 MW
40/44 MW
60/66 MW
100/110 MW
125/137.5 MW
150/165 MW
200/220 MW
250 MW
300 MW
500 MW

The first of six 150 MW Brown Boveri reheat turbine generator sets in a modern power plant. Many similar and larger units have been in operation for years.

Two of the basic reasons why Brown Boveri turbine generator sets are preferred by economy-minded utility companies . . .

1—*Guaranteed efficiency* is invariably matched (and often exceeded) in actual operation.

2—First cost represents *very substantial dollar savings.*

Write for details!

BROWN BOVERI CORPORATION

19 RECTOR STREET —— NEW YORK 6, N.Y.

Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Charlotte, N. C. • Chicago, Ill. • Cleveland, O. • Dallas, Tex. • Denver, Colo. Detroit, Mich. • Hamilton, O. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Miami Fla. • Minneapolis, Minn. • New Orleans, La. • New York, N. Y. Pasadena, Cal. • Pittsburgh, Pa. • Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • San Juan, P. R. • Syracuse, N. Y. • Tucson, Ariz.

For more facts circle 809 on Reader Service Card p 222

For more facts circle 810 on Reader Service Card p 222 →

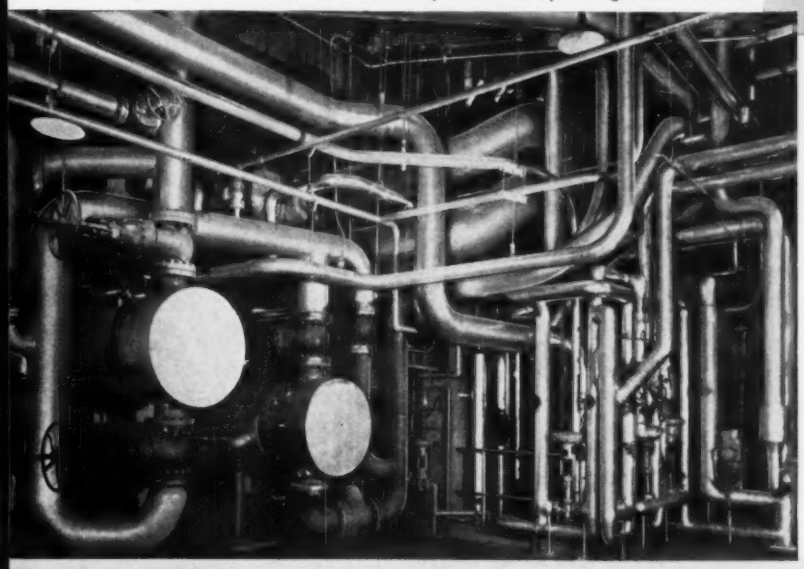
He's Looking For MONEY

Midwest Piping at Kyger Creek plant which has a capacity of 1,075,000 kw and is the largest power plant piping contract (combining fabrication and erection) ever performed by a single contractor.

This Midwest Piping Engineer is going over the customer's piping drawings in the light of his long experience in shop fabrication and field erection. He's looking for ways of doing a piping construction job better and at less cost.

Before a construction job is placed in the Midwest shops for fabrication, experienced engineers prepare Field Erection Sketches dividing each line into a series of subassemblies. These Sketches minimize and simplify the field welding . . . the difficult work is done in our well-equipped shops. They also disclose any discrepancies before fabrication instead of during erection. All erection planning has been done by our engineering staff . . . which reduces field thinking and eliminates guesswork. Erection is from these sketches instead of from the design engineers drawings . . . this speeds up the work and results in a real cost saving and earlier completion of the job.

The next time you have a piping job, you'll find it profitable to call in Midwest.



MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Missouri (P.O. Box 433)

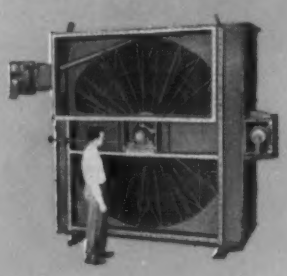
PLANTS: ST. LOUIS, CLIFTON, N. J. and LOS ANGELES

SALES OFFICES:

Asheville (Box 446, Skyland, N. C.) • Atlanta 9—72 Eleventh St. N.E. • Boston 27—426 First St. • Chicago 3—79 West Monroe St. • Cleveland 14—616 St. Clair Ave. • Houston 2—1213 Capitol Ave. • Los Angeles 33—520 Anderson St. Miami 34—2103 Le Jeune Rd. • New York 7—50 Church St. Pittsburgh 19, Pa.—437 Grant St. • St. Louis 4—1450 S. Second St. • San Francisco 11—420 Market St. Tulsa—1640 E. 21st St.

MIDWEST ... PIPING FABRICATORS AND CONTRACTORS FOR MORE THAN 50 YEARS

Here's what you can do about the high cost of fuel



Get the same heat from less fuel with a

Ljungstrom® Package Air Preheater

A significant amount of your fuel is used to heat the combustion *air* in your boilers. A Package Ljungstrom Air Preheater raises the temperature of combustion air by recovering the heat from the exhaust gas. In preheated air, the fuel you are now using will burn more completely, and much more of it will be *productive* heat.

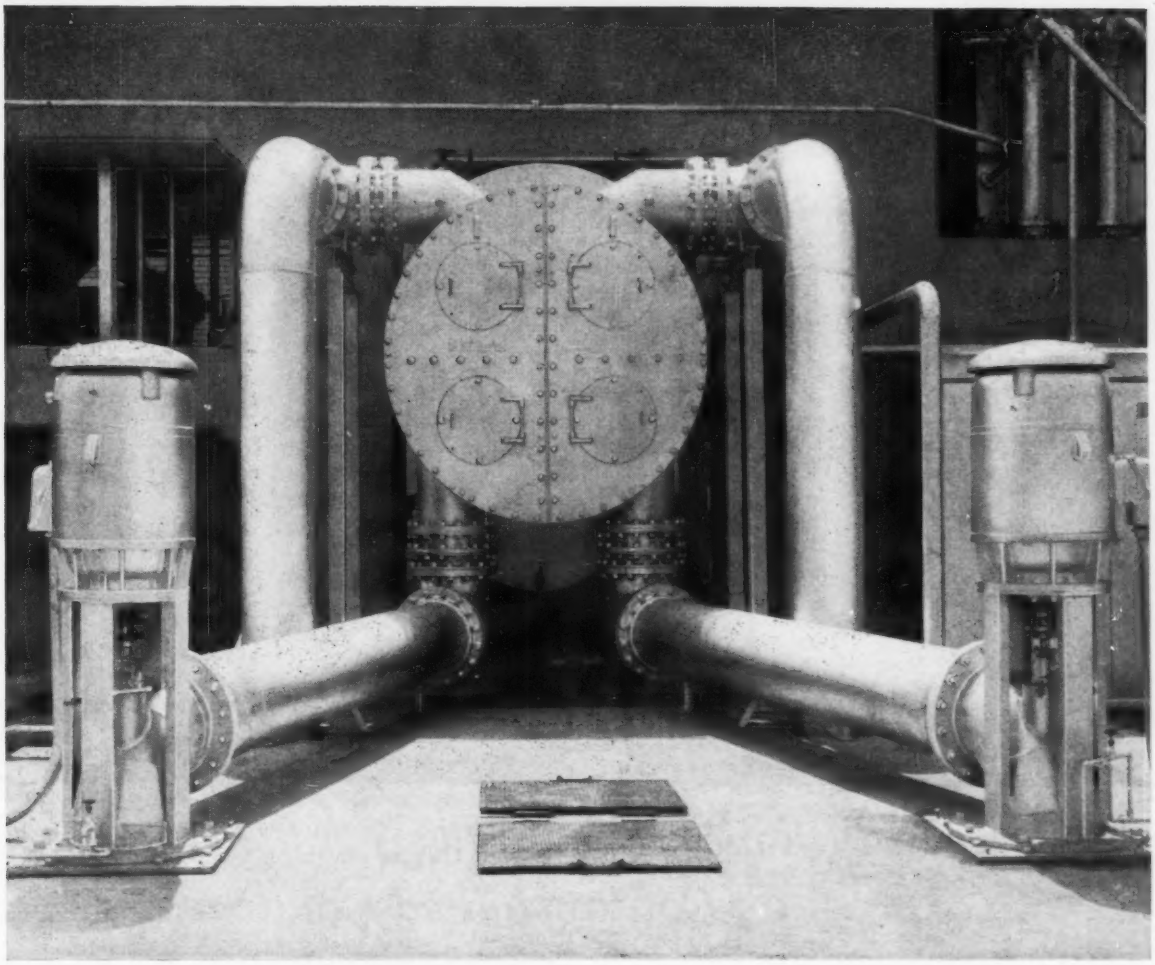
Here is an example of what this means in dollar savings. In one year (1956) a typical Package Ljungstrom installation saved $17,600 in fuel costs. In some installations the Package Ljungstrom saved enough fuel to pay for itself in two years.

Compact Package design of the Ljungstrom gives you all the advantages and economies of the Ljungstrom in a preassembled unit. The Package Ljungstrom is available in vertical or horizontal models that are readily adaptable to any plant arrangement.

For further information, write today for the free 14-page Package Ljungstrom manual.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N.Y.



This power plant was designed and built by the Crisp County Power Commission, Cordele, Georgia.

First planned gas-steam turbine station depends on C. H. Wheeler equipment!

The first power plant in the United States designed from the beginning as a combined gas turbine-steam turbine station, is now in operation!

This combined-cycle, 15,000 kw plant at Warwick, Ga., satisfies the daily peak-load condition as well as base-load requirements. The system is unusually flexible; it can operate with the steam turbine only, or in combination with the gas turbine.

C. H. Wheeler equipment now in service at this history-making station includes a 10,000 sq. ft. Dual Bank, Two-Pass Condenser and two 12″ x 16″ Vertical Mixed Flow Pumps shown above (which supply 10,300 gpm of cooling water) . . . two Horizontally Split Case Condensate Pumps, a Tubejet® Steam Jet Vacuum Pump and a Hogging Ejector.

This equipment symbolizes the contribution C. H. Wheeler makes to the efficient, economical operation of steam generating plants everywhere.

Depend on C. H. Wheeler Condensers for:

- ***Pure condensate***
- ***Lower absolute pressure, higher vacuum***
- ***"Zero" condensate temperature depression***
- ***Deaeration to 0.03 cc. per liter with special designs providing deaeration to 0.01 cc. per liter***
- ***Patented Reverse Flow for faster, easier cleaning of tubes and tube sheets***

C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C. H. Wheeler on a product, you know it's a quality product

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products

For more facts circle 812 on Reader Service Card p 222

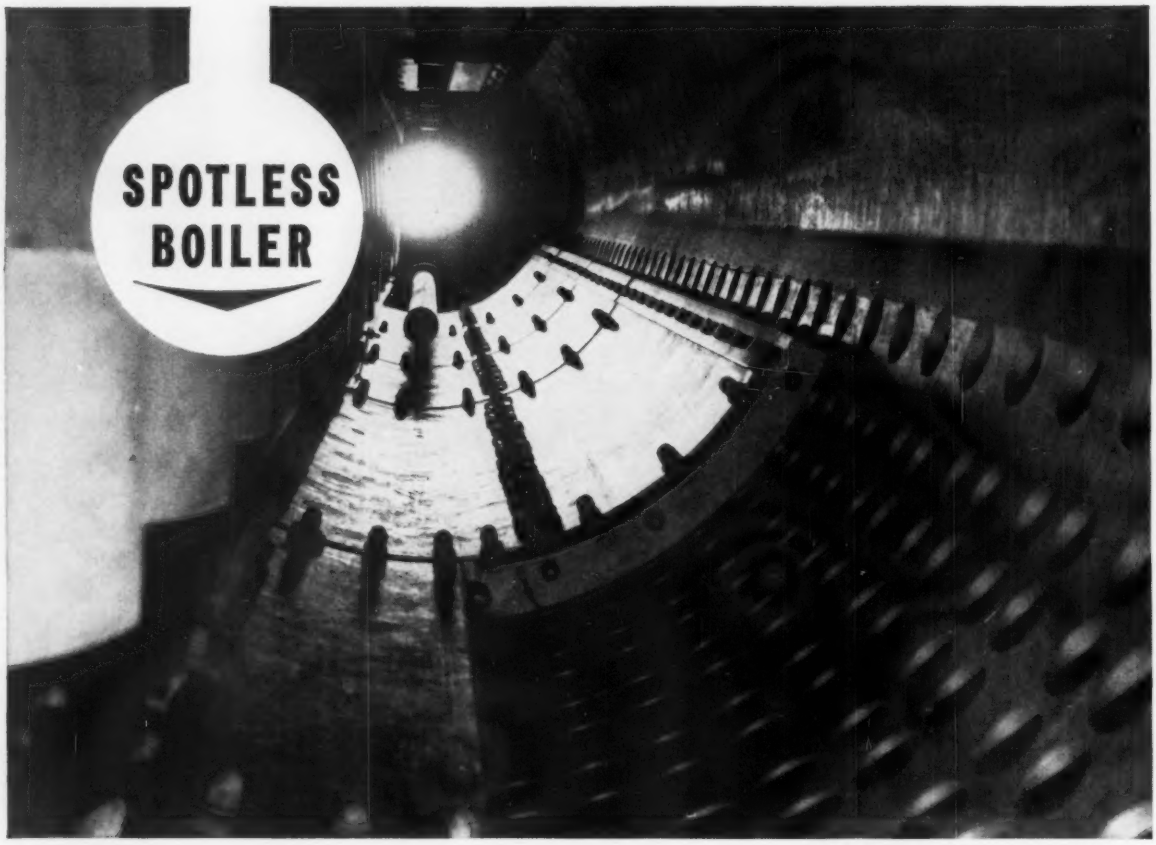
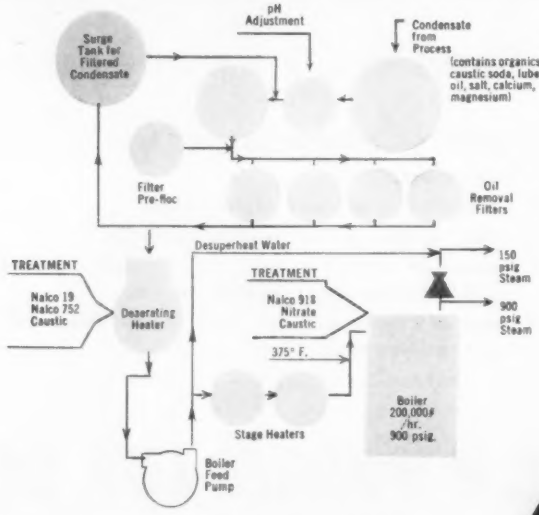


PHOTO COURTESY OF THE DOW CHEMICAL CO.

even though it operates on Contaminated Condensate!



FEEDWATER FLOWSHEET...

Pittsburg, California Plant of The Dow Chemical Co.

Nalco's continuous advisory service, easily as important as chemicals in solving this problem of contaminated condensate, simply doesn't fit into a chart. Consulting Service, in any water conditioning program, complements equipment and specialized services. It is part of the Nalco package . . . of results!

Contaminated condensate from process systems presents a complex water conditioning problem for boiler plant operators. In this system the solids in raw condensate run 15 to 80 ppm. Contaminants are lube oil and other hydrocarbons, caustic soda, salt, and traces of calcium and magnesium . . . a topnotch formula for promoting scale and sludge formation.

Working closely with a superbly cooperative plant operating staff, a Nalco Representative developed the water treatment plan. He provided the continuous counsel and coordination that keeps the boiler as it is shown here: free of sludge and scale . . . clean-to-metal after a full year's operation.

You, too, can count on the Nalco System for permanent, economical answers to water treating problems. Write or 'phone for details.

NATIONAL ALUMINATE CORPORATION

6222 West 66th Place, Chicago 38, Illinois
Northwestern United States, Hawaii and Alaska: The Flox Co., Inc., Minneapolis 3, Minnesota
Canada: Alchem Limited, Burlington, Ont.
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Germany: Deutsche Nalco-Chemie GmbH.
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Nalco

SERVING INDUSTRY THROUGH PRACTICAL APPLIED SCIENCE

For more facts circle 813 on Reader Service Card p 222

LOUIS N ROWLEY, EDITOR • OCTOBER 1958 • ESTABLISHED 1882 **Power**

Tomorrow's prosperity: your job

As we climb out of the recession of 1958, we are moving into a period when conditions will be favorable for the growth of the American economy *and for those individual companies that are prepared to grasp the opportunities that lie ahead.*

Why do we put that stress on *prepared?* Because, surprising as it may seem, much of the plant and equipment of American industry isn't modern and efficient enough to insure profitable growth under increasingly competitive conditions.

What is true of American industry as a whole is equally true of its foundation—the power services that energize production. Anyone familiar with the field knows cases in point: obsolete steam-generating equipment that spells high fuel and labor costs, in-plant electrical systems that won't be able to handle tomorrow's bigger loads economically, shortcomings all through the service systems that provide air conditioning, refrigeration, compressed air and plant water.

Here is our No. 1 job: to start now the planning and modernizing necessary to insure that our companies will have the efficient low-cost power services essential to profitable growth in the booming years forecast for the 1960's.

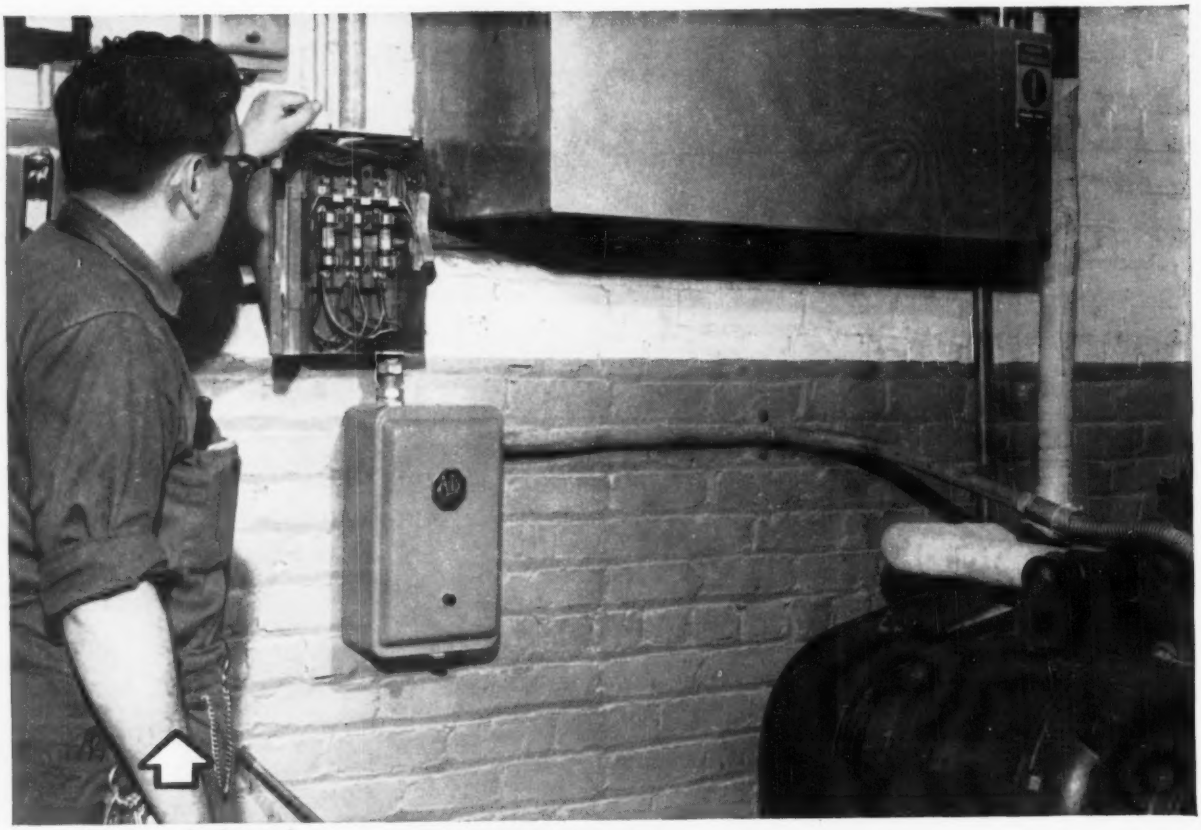
This Plant Design Issue is devoted exclusively to showing the overriding importance of planning *now* for growth and to providing practical help in tackling the job. It opens with a special report from the McGraw-Hill Department of Economics, a report that documents the premise that we can have an era of profitable growth, if we accept the challenge and gear our plant and equipment to the efficiency levels that will be required. Here, if needed, is ample justification when it comes to "selling" your modernization and new-plant ideas to your top management.

Following this report, POWER presents two exclusive surveys of what pace-setting industrial plants and central stations are accomplishing in the drive to reach higher performance levels. Backbones of these two surveys are new and expanded tabulations of the technical features of industrial boiler plants, in-plant electrical systems, steam and hydroelectric central stations, plus graphical summaries of the trends these installations reveal.

To put flesh on this skeleton, we include brief, hard-hitting descriptions of plants having special interest to power-service planners because of advanced design ideas and unusual features. These all add up to a timely and comprehensive picture of what farsighted power-service designers are doing today to realize the promise of the dynamic years ahead, a treasury of ideas for plant planning.

In this planning you will want to include not only the newest in plant layout but the newest in equipment as well. So we also present, in new and convenient form, a roundup of 1958's product advances and design aids.

This comprises, we believe, the greatest package of plant-design information ever assembled for power-service engineers. Use it to bring your systems to the peak efficiency that will permit your company to grow profitably in the 1960's.



Orville L. Welsh ASST. CHIEF ENGINEER, CONTINENTAL BAKING CO.

"Experience proved to us, Fusetron Fuses could save us money and provide safer protection." . . . *Orville L. Welsh*

ASST. CHIEF ENGINEER
CONTINENTAL BAKING CO.
TOLEDO, OHIO

CASE 1

"A refrigeration compressor of ours was frequently being shutdown because the 60 amp. protection we used just could not hold the starting currents.

"After reading over Fusetron dual-element fuse literature sent to us by our company headquarters, we tried them out with great success. In the past twelve months, we have not had to go near the switch or open its cover.

CASE 2

"In another case, Fusetron fuses saved us a considerable amount of money. We installed 600 ampere Fusetron fuses in parallel in our 1200 ampere entrance switch, rather than using the more expensive mechanical type of protective device.

"Personally, I am confident we now have better protection than we could have had with other types of protective devices."

Here's why FUSETRON dual-element fuses provide safer, more dependable and money-saving protection . . . FUSETRON dual-element fuses provide 10 point protection against electrical troubles. This is unlike circuit breakers or ordinary fuses which, except in rare cases, protect only against short-circuits.

IN ADDITION:

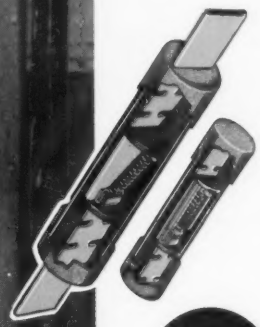
Fusetron fuses require no maintenance or recalibration. They are calibrated at the factory by engineers. Once properly installed, they require no inspection or down-time necessary on mechanically operated devices. There are no hinges, pivots or contacts to stick or get out of order. Dust, corrosion or oxidation cannot increase a Fusetron fuse's capacity or lengthen its blowing time.

After years of inactivity, a Fusetron fuse will give the same safe, dependable protection if called upon to open as it would have on the day it was installed.

Fusetron fuses have high interrupting capacity. FUSETRON fuses can safely interrupt severe short-circuit currents and are adequately safe to meet future circuit growth.

Fusetron fuses save on installation costs. Because their long time-lag prevents them from opening needlessly on motor starting currents or other harmless overloads, Fusetron fuses can be installed in sizes to approximate the load current. This protects against waste of space and money by permitting use of proper size switches and panels.

Why Risk Losses! One needless shutdown . . . one lost motor . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing all other types of protective devices throughout the entire installation with Fusetron dual-element fuses.



For Loads above 600 and up to 5,000 amps . . . Use BUSS Hi-Cap Fuses. They have an interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

for more information write for BULLETIN FIS on Fusetron fuses.
BULLETIN HCS on BUSS Hi-Cap fuses.

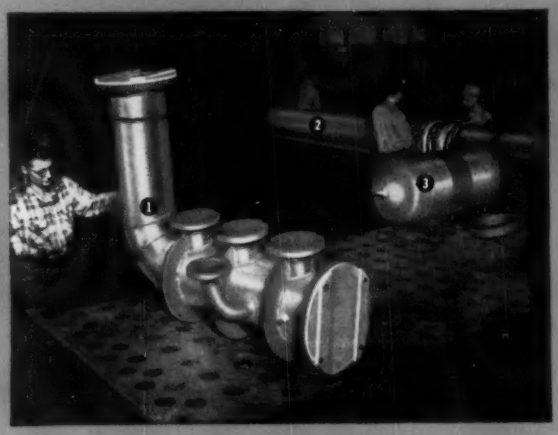
FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

for safe, modern money-saving protection install FUSETRON dual-element FUSES and BUSS Hi-Cap FUSES throughout entire Electrical System!

BUSSMANN MFG. DIVISION, McGraw-Edison Company University at Jefferson, St. Louis 7, Mo.

For more facts circle 814 on Reader Service Card p 222

ALL IN A DAY'S WORK at *Pittsburgh Piping*



These three jobs are typical of the wide variety of custom piping work which we do for the power and process industries. In the background of the photo welders are shown making the heli-arc root pass on 18" O.D., 3.875" wall, chrome-moly main steam piping. In the foreground, ready for final inspection, is a 12" header for a process operation, fabricated of ⅜" aluminum alloy. The pressure vessel, of austenitic steel, is one of many we produce for atomic energy application. The manufacturing of this type of piping requires specialized facilities . . . for engineering, fabricating, testing, assembly, and erection. We have those facilities. Use them on your piping jobs.

Promoting Progress ***IN POWER AND PROCESS PIPING***

Pittsburgh Piping **AND EQUIPMENT COMPANY**
158 49th Street—Pittsburgh, Pa.

Canada: CANADIAN PITTSBURGH PIPING, LTD., 68 YONGE ST., TORONTO, ONTARIO

Atlanta ..... *Whitehead Building* *Cleveland* ..... *Public Square Building*
Chicago ..... *Peoples Gas Building* *New Orleans* ..... *P. O. Box 74*
New York ..... *Woolworth Building*

For more facts circle 815 on Reader Service Card p 222

PLAN '59

How Modern Is American Industry?

A Report by the McGraw-Hill Department of Economics

THE U.S.A. is starting a new period of economic growth, as we leave behind the recession of 1958. This new period presents a challenge to the nation, to the business community and above all to the individual company – to grow *at a profit.*

By now it is clear that growth is the normal way of life for the U.S. Economy. Since 1947, our national product has been growing at a rate of 3.7% a year. And no recession, even the latest and most publicized, has interrupted the trend for long. Now the economy is growing again.

But the conditions of growth are far different from those that prevailed in the years 1947 to 1957.

Today growth in the economy does not mean pressure on capacity, for most industrial firms. It does not mean easy profits. Rather, this is growth under highly competitive conditions, with profits dependent on a firm's ability to hold down costs. **Is our plant and equipment modern enough to do the job?**

A New Survey

To find the answers to this question, the McGraw-Hill Department of Economics has just completed a special survey of business needs for modernization. **The survey shows that it would cost $95 billion to replace today's obsolete equipment.** And this is a priority job, if business is to get costs down for the years ahead.

This tremendous need for modernization presents a challenge to the U.S.A. as a nation. The Communist powers are making a strong and disciplined effort to demonstrate that they can out-produce us – that they can "plow us under" in a contest of industrial strength.

It is a challenge to American business. Our people expect a continuously rising standard of living. Our workers expect wage increases. And often their demands mean price inflation – unless we can achieve sharp gains in output. The public demands higher national income without inflation. This is the challenge to business as a whole.

It is a challenge to the individual firm. Growth in the economy no longer means an automatic rise in sales and profits for any particular company. There are no shortages; industrial capacity is ample. So to participate in growth, the individual firm must achieve better quality or lower costs than its competitors. Otherwise, there will be no profit in growth and no success story for the company.

Is business prepared today for these challenges? The answer, from our study, is clearly "No". The production and distribution facilities of the U.S.A. are not efficient enough to ensure our continuing superiority over the Communist world, to match every wage increase with higher productivity, to do business in a competitive economy at satisfactory profit to the individual firm.

This statement sounds shocking at a time when much industrial capacity is idle and the recession just behind us is being blamed on a surplus of capital goods. But the facts speak for themselves. Here is the record on the past decade of investment in new plant and equipment, and here is our new study of the job that still remains to be done.

THE MODERNIZATION JOB AHEAD: $95 BILLION

The McGraw-Hill Department of Economics asked a wide sample of manufacturing companies, and experts in other industries, "What would be the cost to replace all obsolete facilities with the best new plant and equipment?" Here is a summary of the estimates. (Details on next page.)

MANUFACTURING AND MINING	$34.3 Billion
PETROLEUM INDUSTRY	5.3
TRANSPORTATION AND COMMUNICATIONS	18.4
ELECTRIC AND GAS UTILITIES	12.0
FINANCE, TRADE AND SERVICES	25.0
TOTAL: ALL BUSINESS	$95.0 Billion

Decade of Expansion[1]

Since 1947, private business in the U.S.A. has invested $291 billion in new plant and equipment. Our manufacturing capacity has increased about 80%; electric power capacity, 145%; capacity for basic raw mate-

[1] Figures on "Decade of Expansion" are for the years 1947-1957 inclusive, except where specific reference is made to preliminary data for 1958.

THE McGRAW-HILL SURVEY OF MODERNIZATION NEEDS

Conducted by the McGraw-Hill Department of Economics in August, 1958

INDUSTRY:	AGE OF MANUFACTURING CAPACITY Percent Installed: Prior to Dec. 1945	Dec. 1945 to Dec. 1950	Dec. 1950 to Dec. 1957	COST TO REPLACE OBSOLETE FACILITIES: Millions of $
Iron and Steel	47%	16%	37%	2,855
Nonferrous Metals	47	13	40	1,022
Machinery	41	21	38	3,224
Electrical Machinery	34	18	48	1,917
Autos, Trucks and Parts	42	11	47	2,204
Transportation Equipment (aircraft, ships, railroad equipment)	59	9	32	854
Other Metalworking	54	17	29	2,351
Chemicals	30	23	47	3,070
Paper and Pulp	49	17	34	2,655
Rubber	46	9	45	600
Stone, Clay and Glass	46	20	34	1,840
Petroleum Refining	45	26	29	1,499
Food and Beverages	58	19	23	3,443
Textiles	59	18	23	1,001
Misc. Manufacturing	51	21	28	6,236
ALL MANUFACTURING[1]	48	19	33	34,771

[1] Includes petroleum refinery companies listed under "petroleum industry" in previous table.

rials, by 55%. The distribution and service industries have increased floor space by roughly 50% in the decade. In 1957 alone, business spent $37 billion on new plants and equipment – more than the combined expenditure in all of Western Europe plus Canada.

But all of this expenditure has not made our facilities as modern as supposed, or as modern as we need. Of the $291 billion invested by business since 1947, roughly $157 billion has been for expansion of capacity. Only $134 billion has been spent to replace old facilities with better, more modern equipment. And in recent years, this investment has not purchased as much new equipment as the dollar figures suggest, because prices of capital goods have climbed.

Our postwar capital investment has repaired the worst of the obsolescence accumulated during the depression and war years. But huge amounts of old equipment are still in use, as shown by the table above. This is based on a survey of the age of manufacturing capacity in several hundred companies, representing all of the major manufacturing industries. Almost 50% of our present capacity was installed before or during World War II. More than 65% was installed before Korea. Expert studies of the major non-manufacturing industries show that the age of equipment, in those industries, is even greater.

Thus, of all business plant and equipment, less than one-third is modern in the sense of "new" since 1950; two-thirds is pre-Korea.

This over-all figure is confirmed by a check on specific industries:

- Nearly two-thirds of our metalworking equipment was installed over 10 years ago, according to preliminary results of AMERICAN MACHINIST'S 1958 census.
- Over 65% of the freight cars on our railroads are more than 10 years old.
- Less than half the capacity to process chemicals, rubber or petroleum is new since 1950 – a period that has seen rapid development in such equipment as automatic controls for these process industries.

These examples take on a dollars-and-cents meaning when we recognize that the latest machine tools are about 40% more productive than 1948 models, and that a combination of new freight cars and modern freight yard equipment can reduce operating costs up to 50%. New instruments, that automatically direct the flow of a chemical (or other raw material) process, can often reduce processing costs enough to pay back the cost of the instruments in one year. These savings cannot be made in older plants. By using obsolete facilities, our industries accept a waste in labor and materials that totals many billions of dollars per year.

Why Productivity Must Rise

The U.S.A. can ill afford this waste. In the economic struggle between the free world and Communist world, our margin of superiority depends on the efficiency of our productive facilities.

For the growth of our own economy, we shall need a sharp rise in productive efficiency. During the next ten years, American business must provide the goods and services required for a population that will increase by 32 million. And the increased population will expect higher living standards. Furthermore, the population in ten years will include a higher proportion of dependent persons – children and retired people – and a smaller proportion of working age men. Thus, with a relatively smaller labor force, industry must provide more goods for more consumers.

At the same time, industry must strive to hold the line against rising costs. In an economy with a tight

labor supply, we cannot count on restraint in wage demands, however desirable such a development might be. In the past ten years, hourly wage rates have increased over 5% per year, nearly twice as fast as output per manhour. And this disparity may well continue – causing still more inflation–unless we make more rapid gains in productivity.

We can make these rapid gains – if industry goes all out to modernize its equipment. Output per manhour (in manufacturing) has increased only 2.5% per year since 1951. But this compares with gains of 4% a year in 1947-1950, and over 5% in the 1920s. Today the machines and techniques are available for us to equal, or exceed, these records – to raise output per manhour at least 5% per year. This is a job that can, and indeed must be done, to assure growth in the economy without inflation.

The Job Ahead

The dimensions of this opportunity are shown by the table on the previous page. In its survey on the need for modernization, the McGraw-Hill Department of Economics asked a wide sample of manufacturing companies how much it would cost to replace *all* their out-dated facilities with the best new equipment available. The Department also interviewed experts in each of the nonmanufacturing industries, to find answers to this question. The answers add up to a staggering bill for new plant and equipment.

Modernization of over-age facilities – replacing only what is really obsolete, by today's production standards – would require a total capital investment of $95 billion, or nearly $20 billion per year for the next 5 years.

Furthermore, new production techniques will soon make *today's* plants obsolete, in many cases. Thus, to keep pace with technical advance *from 1958 on*, will require continuing expenditures of $8 to $10 billion per year for modernization.[1]

The total expenditure to wipe out the backlog of obsolete facilities, and keep up with continuing technical advance between now and 1963, would be at least $135 billion.

The U.S.A. has never spent such a sum on the modernization of industrial facilities. Capital expenditures of boom dimension have, in the past, been associated only with the urgent expansion of capacity. **Some forecasters are now saying that because industrial capacity is adequate, the next few years will be a period of low capital investment. The figures above make clear that this would be a national calamity.** The opportunity is there–and the challenge–to invest record amounts of capital in the modernization of plant and equipment.

A National Problem

This also is a challenge to the U.S.A. as a nation. For 100 years, this nation has been looked to as the model of economic development by the rest of the world. For the first time, we face a serious challenge by another nation and another economic system that claims to be better. In a carefully documented 111 page study released in May, the U.S. State Department declared that "the most serious threat" to the U.S.A. today is the drive for economic supremacy by the Soviet Union.[2] Although a much smaller nation industrially than the U.S.A., the U.S.S.R. is today increasing its national output at a rate of 7% per year and its output per manhour by 4% per year.

The U.S.A. does not have to match these specific figures, which represent the results of forced labor in a country just starting to develop industrially. In the contest to win uncommitted nations, the statistics are not likely to be quoted exactly, in any case. But our over-all growth in national output and living standards must be so impressive as to leave no question of superiority. Our factories must be showplaces of modernization to the foreign visitor that will leave him unable to say "I saw much better" in Britain, or West Germany, or Russia.

This is the challenge to the nation –a political challenge to be sure. But it coincides with the challenge to the business community and the individual firm. And the way to meet it is the same: by thorough and rapid modernization of our plant and equipment – not by the slow and steady pace of recent years, but at an accelerated rate that reflects the greater pressure for output at lower cost.

Obstacles To Be Overcome

We must face up to the fact that real obstacles – both technical and financial–stand in the way of faster modernization. Some companies do not have the technical "know-how" required for the latest production techniques. Many more lack the financial resources. How can we overcome such obstacles, and speed up the replacement of old facilities?

In the course of its study, the Department of Economics obtained comments on these questions from many executives. One of the problems, as we noted above, has been the urgent pressure to expand capacity during most of the postwar period. In giving their attention to this problem, companies have sometimes overlooked the chance to modernize older plants.

In some cases, equipment has been kept in place because it was satisfactory, and the users were not aware of still newer designs. Some equipment users believe that equipment makers are not sufficiently aggressive in designing and demonstrating new models.

The biggest obstacle – and one that presents a persistent problem – is the shortage of funds in many companies that need and want to modernize. For all corporations, the cash flow from retained earnings and depreciation has increased by more than $5 billion from 1953 to 1958. But a number of key indus-

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[1] This estimate is based on technical developments reported by McGraw-Hill editors and current price trends for capital goods. It is consistent with the plans for modernization expenditures in 1958-61 reported by companies in a McGraw-Hill survey conducted in April, 1958.

[2] "The Sino-Soviet Economic Offensive in the Less Developed Countries" – U.S. Department of State, May, 1958.

MODERNIZATION PAYS

Profits on modernization—like all business profits—have come down since 1955. However, modernization, in contrast to new capacity, still offers a relatively quick return on investment. Here are companies' answers to the question: "In cases where you are actually replacing old facilities with new plant and equipment in 1958—how soon do you expect these replacement expenditures to pay off?"

	PERCENT OF COMPANIES ANSWERING			
INDUSTRY:	1 to 2 yrs.	3 to 5 yrs.	6 to 8 yrs.	9 yrs. and over
Iron and Steel	11%	56%	11%	22%
Nonferrous Metals	29	71	0	0
Machinery	12	56	12	20
Electrical Machinery	29	57	7	7
Autos, Trucks and Parts	40	60	0	0
Transportation Equipment (aircraft, ships, railroad equipment)	7	53	20	20
Other Metalworking	38	33	10	19
Chemicals	10	53	21	16
Paper and Pulp	22	22	22	34
Rubber	33	33	34	0
Stone, Clay and Glass	0	57	36	7
Petroleum Refining	16	50	17	17
Food and Beverages	16	44	12	28
Textiles	37	47	5	11
Misc. Manufacturing	9	52	13	26
ALL MANUFACTURING*	18	50	14	18

**Note:* Answers to a similar question, in a 1955 McGraw-Hill survey, were as follows: 1-2 years: 17%, 3-5 years: 64%, 6-8 years: 11%, 9 years or more: 8%.

tries have failed to keep pace with the general trend. **These include some of the areas where the need for modernization is most urgent: the railroads, large sections of the textile industry, some mining industries and many small to medium-size companies in manufacturing generally.** The problem of these industries and companies has grown more acute in 1958 – since their profits have declined much more than the average for all business.

Any plan to step up the pace of modernization generally must deal with the special situation in these problem areas. Depressed industries and companies need outside help, if they are to modernize. Such help would include a stronger flow of technical information and advice (and occasionally, venture capital) from the more prosperous, inventive industries – as well as advice from equipment suppliers and distributors, industrial publishers and consultants. There is also a public responsibility to help in the problem areas—not with handouts of government money, but with technical assistance and help in finding private capital (like the efforts now being pursued by the Small Business Administration).

Certainly we should lose no time in reforming those provisions of the federal tax laws that now impede investment in modern equipment by hard-pressed firms – especially the outmoded and unfair restrictions on rates of depreciation for tax purposes. At present, the tax regulations require that depreciation be computed over relatively long periods of "useful life" for most types of equipment. And this is a primary reason for the lag in modernization. Machinery generally becomes obsolete long before the expiration of its "useful life" as specified in tax regulations. But it is difficult for companies – especially small companies – to set aside cash for rapid replacement, unless the full amount to be set aside is exempt from income tax. Canada and most European nations allow more rapid depreciation for tax purposes than does the United States.

A combination of self-help with technical help, and a fair break from the tax laws, would do much to reverse the spreading tide of obsolescence in depressed industries, and in many small companies.

PLAN '59

It is this combination that McGraw-Hill advocates as "PLAN '59", to help business modernize *now* for growth and profits. This is what it will take to make a start in 1959 on the $95 billion job of modernization, disclosed by the study we have just completed:

1. A better flow of technical information on where and how to modernize business plants and equipment.

2. Careful review by the individual company of its own opportunities to modernize at a profit – then action to replace obsolete facilities.

3. Reform of the tax laws, to allow more realistic deductions for depreciation, and permit more companies to finance adequate modernization programs from this source of funds.

Much of this program is already underway. The 34 McGraw-Hill Publications, and many suppliers and distributors of industrial equipment, have stepped up their information programs to start the modernization drive. Preliminary plans of manufacturing companies show a strong emphasis on capital spending for this purpose. In August, Congress passed a bill providing limited tax relief for small business.

But the real task of modernization still lies ahead. It is the greatest challenge, and the greatest opportunity, confronting American business as we move forward into 1959.

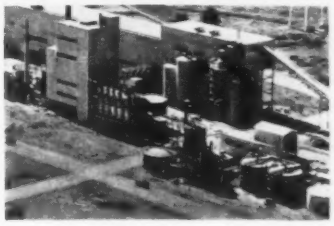
PLAN '59

Power reports on . . . Industrial plant design

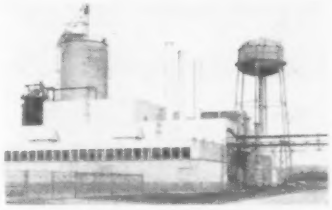
By L E STEWART, Assistant Editor

Here, in 28 pages, are highlighted some of the industrial power-service designs that reflect sound planning for tomorrow

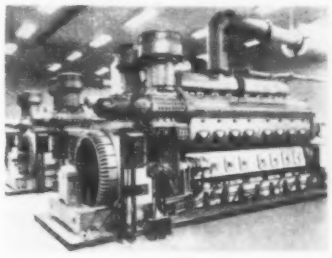
- Consulting engineers design trend-setting aluminum uses into new Alcoa plant p 78



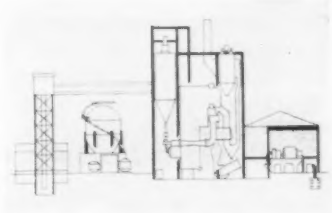
- Paper-mill power services are integrated production tool in 150 ton-per-day plant p 82



- Ford Motor Co plant supplies compressed air as a major power service p 85

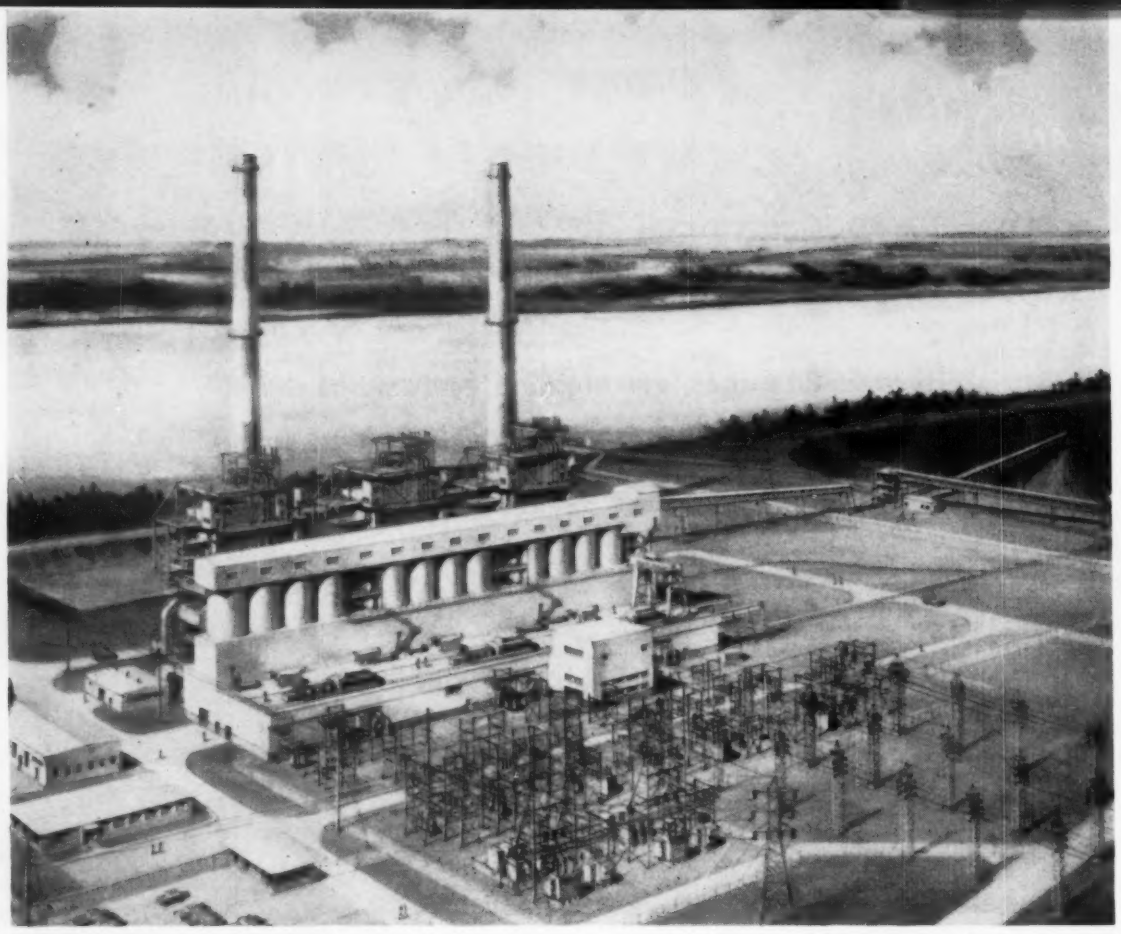


- Now diesel engines are quiet neighbors as soundproofed diesel-generator plant is designed for G.M. factory in Brazil p 88



- Three-way power expansion updates American Cyanamid's Bound Brook plant p 92

Plus . . . Nine pages of new design details covering plant power services



DESIGNER'S VIEW of Warrick plant pictures initial 3-unit plant topped by 400-ft stacks. Aluminum siding for some structural parts, special aluminum turbine-maintenance housing, electrical-distribution equipment and many other items make a unique plant

Consulting engineers open their files to show . . .

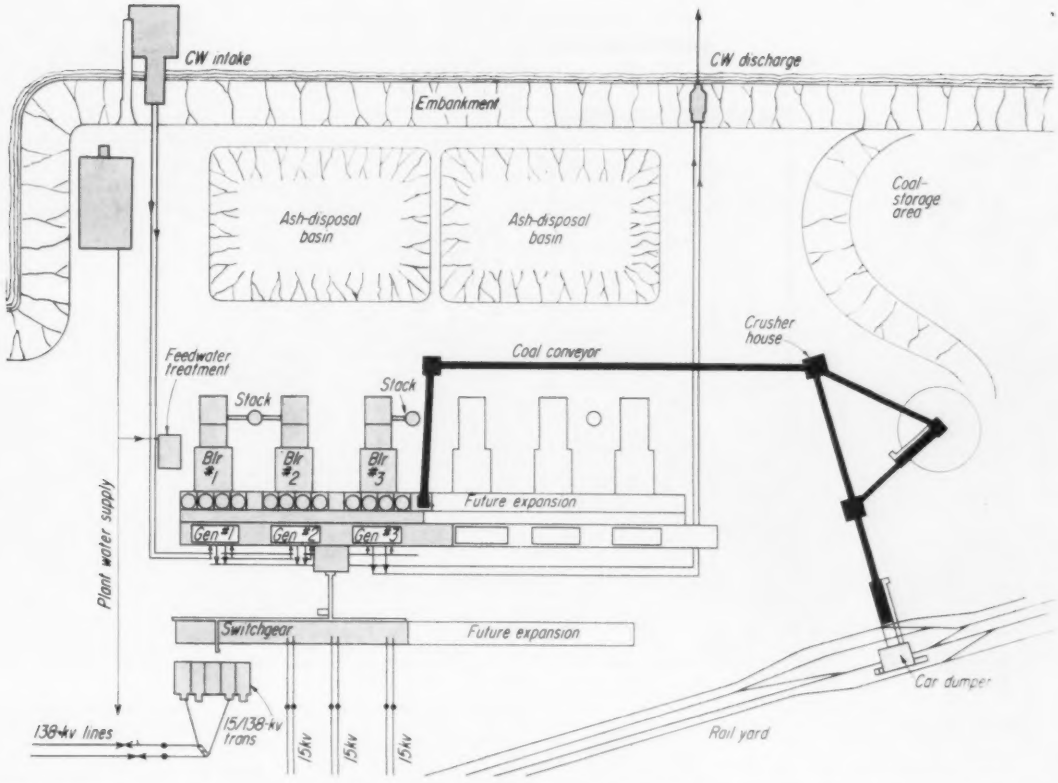
Alcoa's plans for trend-setting

Aluminum Company of America is presently building their new Warrick aluminum-production plant near Evansville, Ind. When this plant goes into operation, Alcoa will have in the power-plant section a showhouse for aluminum products in utility services. POWER editors asked Alcoa and Ebasco Services Incorporated, job consultants, to describe background engineering work that ends in a trend-setting plant. Result: a story of Warrick power plant from the designer's viewpoint.

To begin with, engineers were working on a *big* industrial power plant—three 125-mw units initially, with possible expansion to six units. Power requirements for aluminum production are large, and service reliability is all-important, so standby capacity was a must item. In addition, Alcoa wanted to use Warrick as a demonstration plant for uses of aluminum in the power services. This produced a 3-point design program for Warrick: (1) 375-mw plant with provisions for eventual 100% expansion (2) maximum reliability for all components (3) maximum economic use of aluminum in plant. With these three items in mind, we turned to the engineering files for plant details.

Plant's location is on the Ohio River near Evansville, adjacent to the 60-mw B C Cully Station of Southern Indiana Gas & Electric Co. Earthquake history required a 10% seismic factor in design of all structures. Site conditions dictated placement of all major equipment above grade. Plant orientation was determined by need for initial power from Cully Station and the direction of expected expansion for smelter units.

Heat cycle was designed on a unit basis, with no steam crossover between units. Six turbine bleed points will serve three low-pressure closed heaters, two high-pressure heaters, a deaerator and, on one unit, an evaporator. Two full-capacity condensate pumps per unit will pump to the l-p heaters through the inter-and-after condensers of the steam-jet air ejector, and the gland steam leak-off condenser. Two full-capacity,



PLANT LAYOUT runs parallel to river and smelting units, with provision for expansion in direction of possible smelter-unit growth. Potential doubling of plant capacity will require added rail yards, extra cooling-water line and higher belt speeds for coal conveyors

use of aluminum in the power services

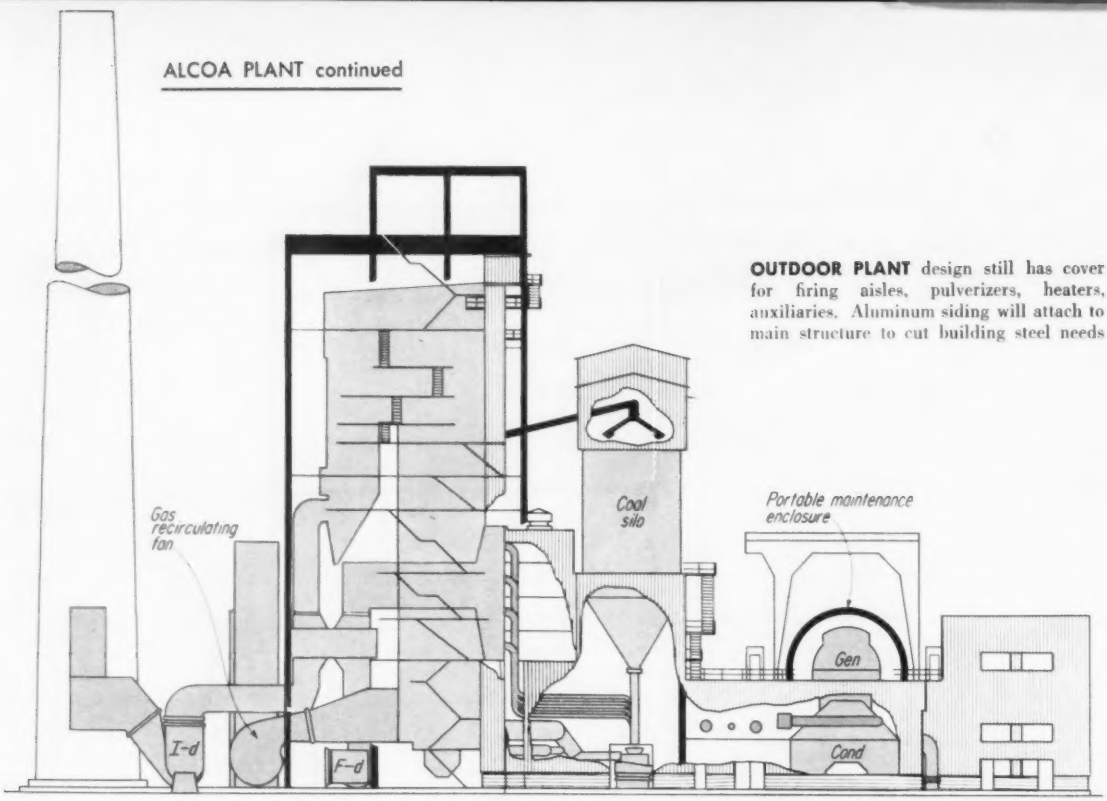
constant-speed boiler-feed pumps will take their suction from the deaerator storage tank and deliver the water to the economizer through the high-pressure heaters.

Each unit will have a 60,000-gal all-aluminum condensate-storage tank interconnected with tanks for other units. Designers provided three complete pressure-reducing and desuperheating systems, one per unit, to produce saturated steam for plant uses. Steam will run through heat exchanger in the smelter plant so condensate returns to power plant. The entire 3-unit station was sized so that 90% of plant's full load can be handled by two units.

Turbine-generator units selected were tandem-compound double-flow turbines designed for 1800 psig, 1000 F at the throttle and reheat to 1000 F. Use of 1050 F could not be justified in this case. As an emergency measure, units can be operated at overpressure. Generators will be standard hydrogen-cooled design, generating at a nominal 160,000 kva and 15,000 volts. The turbine-generators will be supported on concrete pedestals as outdoor installations. Feedwater heaters are to be clustered around condenser and pedestal base.

The two lowest-pressure heaters will have aluminum tubes, others standard metal. A movable aluminum cover was designed to roll over entire unit for any maintenance work. Condensers selected were single-shell two-pass divided-water box type units supplied with aluminum tubes in steel tube sheets. Designers figure use of the aluminum tubes on this job will save about $50,000 per condenser. Inter-after condenser will also contain aluminum tubes.

Steam generators are to be outdoor installations with the exception of firing aisles and small sheds around steam-drum ends. Three boilers will rate 1,000,000 lb per hr at 1975 psig, 1005 F, and reheat to 1005 F. Steam temperature will be controlled by spray attemperation and gas recirculation. Each unit is designed for 16 pulverized-coal burners mounted in the front furnace wall. Four pul-

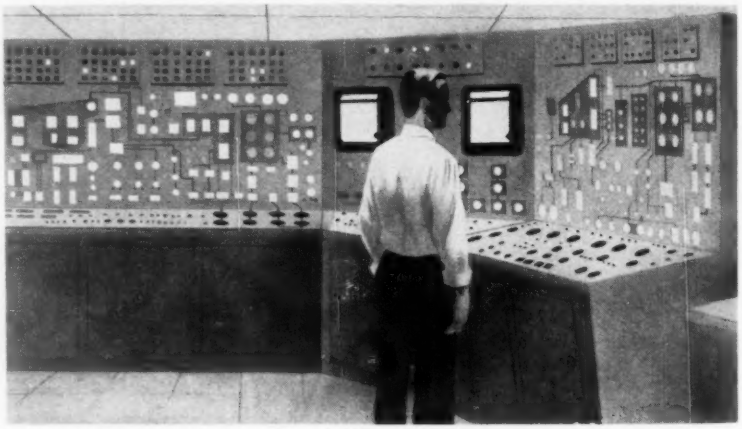


OUTDOOR PLANT design still has cover for firing aisles, pulverizers, heaters, auxiliaries. Aluminum siding will attach to main structure to cut building steel needs

verizers will supply fuel to four burners each with enough spare capacity to carry full load with one pulverizer out of service. Exit gases are to run through air preheaters and mechanical dust collectors before going to 400-ft concrete stacks, one for each pair of boilers. The second stack will be fitted with a venturi cap to compensate for flow reduction until fourth boiler is installed.

Water treatment was designed to condition well water for use as boiler makeup. A complete demineralizing plant, capable of supplying treated water for the 3-unit station, will occupy a special building near the first boiler.

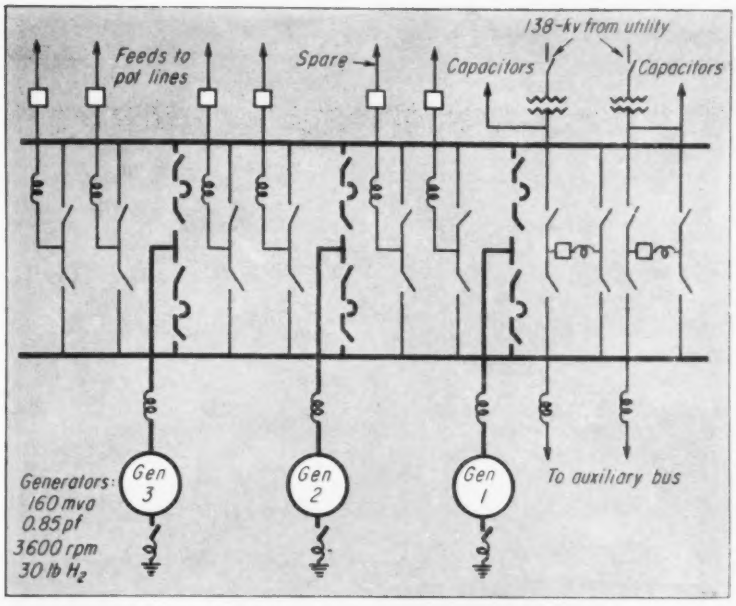
Coal-handling equipment was sized to supply three units initially on eight hr-per-day operation. Possible plant doubling will require 2-shift operation and speedup of conveyor belts. Coal system was designed so that a change in sprocket sizes would complete changeover. Primary coal source will be rail shipments, but designers provided for truck and barge shipments as a standby. Rail yard will hold 100 cars at first, can be expanded to 200-car capacity later. Rotary car dumper and combination rail-truck hopper will feed conveyor system, with storage coal reclaimed from a special hopper. Distributing conveyors will deliver coal to 12 steel coal silos, four per boiler.



CENTRALIZED CONTROLS mounted on BTG panels put indicators and complete controls for three units at operator's fingertips. BTG panel for fourth unit can be added later

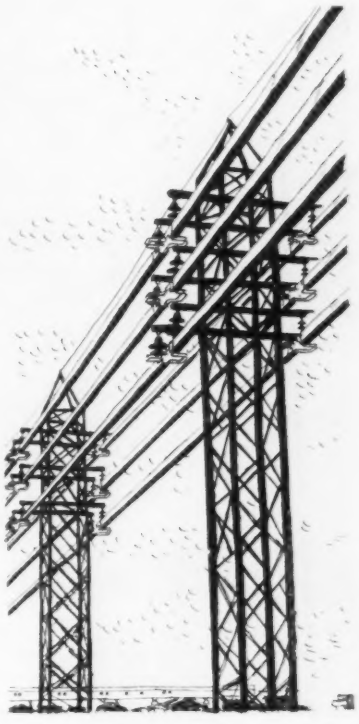
Ash-collection system initially will deposit in areas behind boilers. When this space is needed for other equipment, ash will be sluiced to the permanent ash area beyond the main coal-storage pile.

Electrical distribution was designed to withstand high 15-kv line faults and to create a flexible switching arrangement. Aluminum-enclosed isolated phase bus will carry current from generator terminals to the outside of building wall. Cubicle will enclose capacitors, lightning arrestors and transformers for instrumentation, with a separate aluminum cubicle for neutral equipment. Exposed structural aluminum bus, supported from aluminum towers, will carry generator output from 15-kv switchyard. Standard generator instrumentation will be provided on BTG (boiler-turbine-generator) board in control room. Normal bus switching will be done from this point.



ELECTRICAL - SYSTEM flexibility allows switching of any generator from one 15-kv bus to other from BTG control panel. Generator bussing and distribution at 15-kv require reactors to regulate short circuit current and duty on circuit breakers.

BUS TOWERS constructed of aluminum structural members will carry 3-in. by 5-in. rectangular, extruded, tubular aluminum busses from switchyard on to smelter plant. The busses suspend from two 10-in. strain insulators at each tower



Principal power-plant equipment

Aluminum Company of America, Warrick Power Station

Turbine-generators, 3 — General Electric Co
125,000 kw, 160,000 kva, 3 ph, 60 cycle, 15,000 v, hydrogen-cooled, 3600 rpm, 1800 psig, 1000-F throttle, 1000-F reheat

Steam generators, 3 — Babcock and Wilcox Co
1,000,000 lb per hr each, 1975 psig, 1005-F superheat, 1005-F reheat, four pulverizers—16 coal burners per unit, spray attemperation and gas recirculation for steam-temperature control

Air preheaters, 6 (2 per unit) — Air Preheater Corp

Induced-draft fans, 6 — Westinghouse Electric Corp, Sturtevant Div
717,000 lb per hr at 12.4-in. wg, 275 F, 900 hp, 600-rpm drive

Forced-draft fans, 6 — Westinghouse Electric Corp, Sturtevant Div
647,000 lb per hr at 9.4 in. wg, 80 F, 450 hp, 720-rpm drive

Gas-recirculating fans, 3 — Westinghouse Electric Corp, Sturtevant Div
325,000 lb per hr at 9.3 in. wg, 650 F, 600 hp, 600-rpm drive

Dust collectors, 9 (3 per unit) — Western Precipitator Co

Soot blowers — Diamond Power Specialty Corp

Condensers, 3 — Foster-Wheeler Corp
75,000 sq ft, aluminum tubed

Circulating-water pumps, 6 (2 per unit) — Foster-Wheeler Corp
42,000-gpm capacity, 88.7-ft head

Condensate pumps, 6 (2 per unit) — Worthington Corp
685,000 lb per hr, 560-ft head

Ash- and dust-handling equipment — United Conveyor Corp

Stacks, 3 — M W Kellogg Co

Feedwater heaters, 15 (5 per unit) — Foster-Wheeler Corp
No. 1 l-p—3150 sq ft; No. 2 l-p—3080 sq ft; No. 3 l-p—2715 sq ft; No. 1 h-p—5465 sq ft; No. 2 h-p—6285 sq ft. No. 1 and 2 l-p heater—aluminum tubes

Deaerators, 3 (1 per unit) — Cochrane Corp
1,100,000 lb per hr, spray tray, 101.5-psig pressure

Chemical-feed system — Milton Roy Co

Boiler-feed pumps, 6 (2 per unit) — Pacific Pumps, Inc
1,100,000 lb per hr, barrel pumps, 3580 rpm, 5600-ft head

Desuperheating and pressure reducing — Copes-Vulcan Div, Blaw Knox Co

Main power transformers, 2 — Westinghouse Electric Corp
60,000 kva, 138/15 kv

Power-regulating transformers, 2 — Westinghouse Electric Corp
60,000 kva, 15 kv, ± 7½% regulation

Auxiliary power transformers, 6 — Pennsylvania Transformer Co
10,000 kva, 15,160/4160 v

Auxiliary power transformers, 3 — Pennsylvania Transformer Co
1000 kva 4160/480 v

138- and 15-kv air-break switches — Federal Pacific Electric Co

138-kv automatic grounding switches — Southern States Equipment Co

15-kv outdoor metalclad switchgear — Westinghouse Electric Corp

15-kv air-core reactors, 33 — General Electric Co
6—2500 amp; 9—500 amp; 18—3200 amp; all outdoor units

15-kv capacitor stacks, 2 — Westinghouse Electric Corp
14,400 kvar each

15-kv lightning arrestors — Westinghouse Electric Corp

Generator main leads isolated phase bus — I-T-E Circuit Breaker Co
15 kv, 6500 amps

Auxiliary switchgear, 4160 v — I-T-E Circuit Breaker Co

5-kv bus — I-T-E Circuit Breaker Co

480-v switchgear — I-T-E Circuit Breaker Co

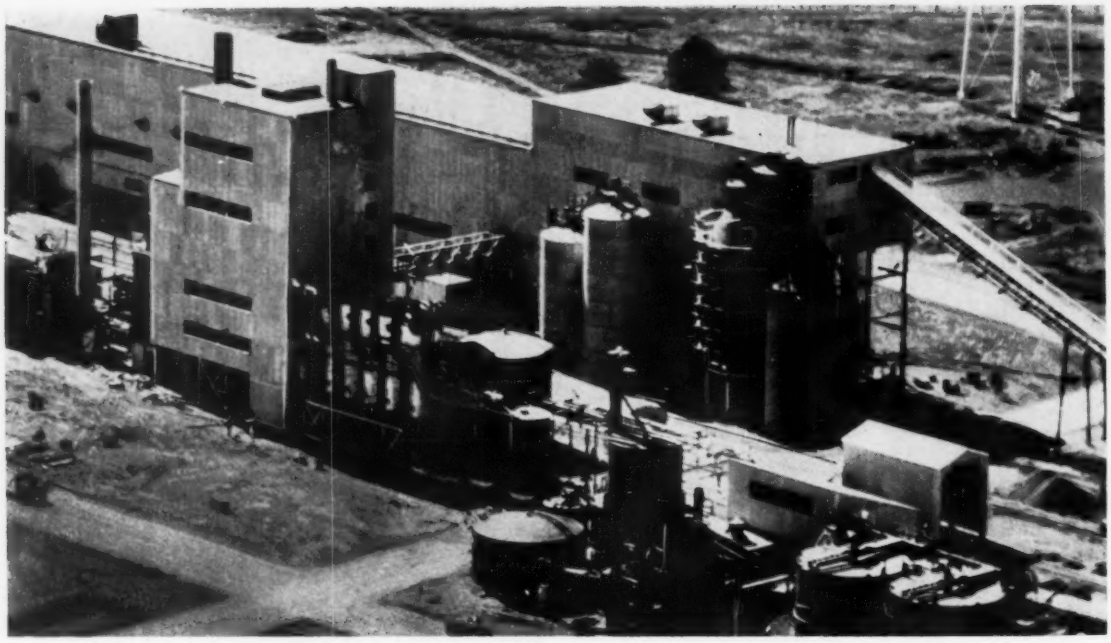
Power piping — Grinnell Co

Hollow-forged pipe — Babcock and Wilcox Co

Combustion controls — Hagan Chemicals & Controls, Inc

Load and frequency control — Leeds and Northrup Co

Engineering and construction — Ebasco Services Inc



POWER-SERVICES and chemical-recovery equipment forms a power production line in new paper mill. Center building houses recovery boiler with black-liquor evaporator on one side, precipitator, power boiler on other. New power unit is planned for future

Dierks bets $12 million on business growth as they start new paper mill

150 ton-per-day integrated kraft mill puts power-services section to work as regular production tool. Design allows room for future expansion

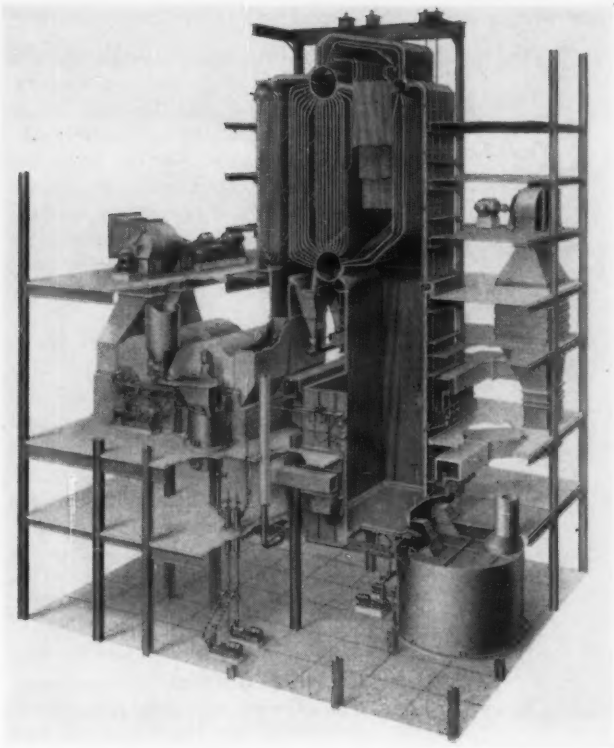
Paper mill at Pine Bluff, Ark. is another step forward for the 75-year-old Dierks Forests Inc. They entered the pulp and paper business recently with startup of the $12 million, 150 ton-per-day mill. Paper mill obtains most of its wood-chip requirements from the Dierks lumber mills, and has on tap for future expansion the timber from the lumber company's 1,500,000 acres of southern-pine tree farms. Paper mill was designed to take maximum advantage of latest advances in chemical-recovery and power-services equipment while still aiming for minimum cost. Future expansion needs were worked out in design stage so later growth could be handled for the lowest cost.

Power services in an integrated paper mill fall in a completely different category from the usual industrial plant. Chemical recovery is so intimate a part of the pulping process that power services are no longer a sideline item but fit in the heart of the process as a production tool. The raw material is weak black liquor and products are reconstituted chemicals and process steam. As a result, a description of utilities includes other equipment that combines to make up this production tool.

Chemical recovery is handled in a special black-liquor boiler built to handle recovery needs for a 165 ton-per-day pulping process — capacity enough to handle future plant growth. Smelt discharges from the recovery unit to a smelt-dissolving tank through a condensate-cooled spout. Molten smelt is disintegrated as it enters the spray-nozzle tank.

Evaporator unit is located outdoors, alongside the recovery-boiler building. Unit is a 5-shell quintuple-effect black-liquor evaporator designed as a self-supporting section. First-effect evaporator and surface condenser have stainless tubes and protections. Evaporators concentrate 155,000 lb per hr of weak black liquor to 45,000 lb per hr of strong liquor containing 45% dry solids. All liquor and condensate pumps, with the exception of the weak-liquor feed pump, are constructed of stainless steel.

Black liquor is pumped over from the pulp mill to a large storage tank near the multiple-effect evaporators.



Recovery unit is production tool

Black-liquor boiler serves a multiple purpose in paper-mill operation: generation of process steam, chemical recovery and process-waste disposal. Most important function is recovery of the salt cake used in cooking the wood pulp. Entire process in kraft mill becomes economically possible because of cost savings in chemical makeup, less fuel for process steam and burning of waste.

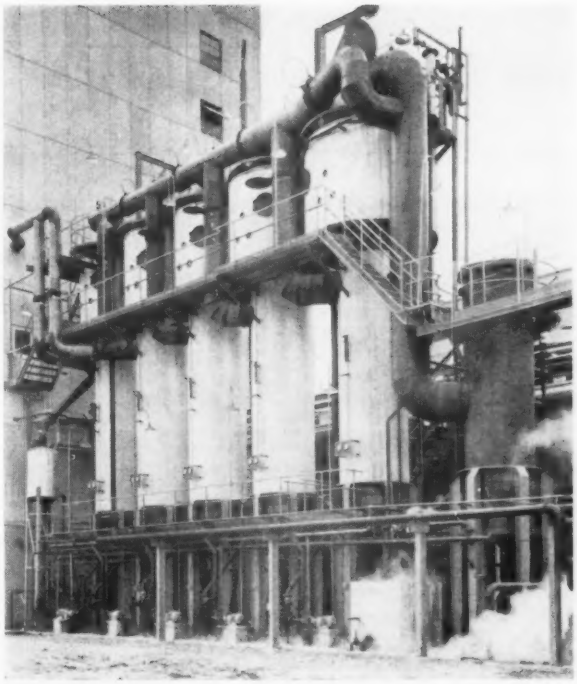
Dierks' unit is a 165-ton recovery boiler designed for 600-psig superheater outlet pressure and 750-F steam temperature. Black liquor is received in the cascade evaporator at 45% solids concentration and is further concentrated to 67% dry solids prior to spraying in furnace.

Black-liquor nozzles spray high-density liquor for suspension burning. Reduction takes place on furnace floor. Furnace hearth is of decanting type which eliminates direct contact between flowing smelt and wall refractory. Superheater is wide-spaced tangent-tube construction to ease cleaning problems. Secondary air injects into the furnace tangentially to achieve highest combustion efficiency, minimize carryover problems in boiler banks and precipitator.

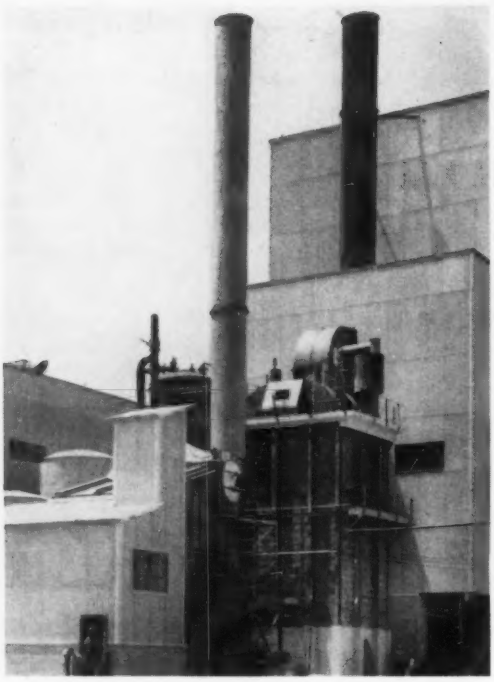
A metered flow is pumped to evaporator heating elements. Liquor loops out between third and second elements to an insulated soap-separation tank. After passing through the second and first evaporator elements, the concentrated liquor is pumped to storage.

Motor control centers for starting all equipment in this evaporator area are enclosed in a pressurized control room. Pushbutton control panel centralizes evaporator operation, is designed for future expansion.

Concentrated black liquor from storage tank is pumped into the wet-bottom pan of the boiler precipitator. One stainless-steel centrifugal pump handles pumping requirements, with a duplicate for standby and to fill a part of future growth needs. Liquor is pumped from precipitator pan to cascade evaporator at the boiler-gas outlet. The cascade evaporator uses boiler flue gas to concentrate liquor to the 67% solids needed for spraying into the boiler furnace. Makeup chemicals in the form of salt



EVAPORATOR'S quintuple-effect shells reduce black-liquor moisture to 55%. Integrated structural design cuts installation costs



POWER BOILER, precipitator line up by recovery-boiler building. Housing covers power-unit controls, firing aisle

cake are added after cascade evaporator before pumping to burners.

The electrostatic precipitator is a wet-bottom type designed to handle salt-cake-laden flue gases from the cascade evaporator. The salt cake collects on the precipitator electrodes and is returned to the black liquor in the wet-bottom pan.

Power boiler is a 2-drum watertube unit for outside installation. The boiler is designed for 650 psig and arranged for initial operation at 275 psig and 745-F total steam temperature. Future operation will be at 600 psig and 750 F. A control-room building is located at the firing end to provide protection for the control instruments and operator, and is the unit's only enclosure. *Fanmix* burners fire gas with oil as standby fuel; do not require forced-draft fan for operation.

Makeup water for power, recovery boiler is treated in hot-process softener. Lime and gypsum are added to reduce alkalinity and cut silica to 1 ppm. Treated water flows through three *Anthrafilt* pressure filters and three zeolite softeners for removal of residual hardness. Feedwater is delivered from deaerator section to boilers by one steam-turbine drive, one motor-drive feed pump.

Power boiler has complete combustion control, 3-element feedwater control, flame-safety and interlock system. Process demands may require going from hot standby to full load in less than ten minutes. Recovery boiler has combustion control and 3-element feedwater control.

Electrical feed comes in from utility - owned substation at 13.8 kv, distributes radially from main breaker to five feeder breakers. Voltage stepdown occurs at five load centers, using metalclad gear, enclosed in pressurized control rooms.

Principal power-plant equipment

Dierks Paper Co, Pine Bluff, Arkansas

Power boiler, 1 — Erie City Iron Works
2-drum watertube, 50,000 lb-per-hr maximum continuous capacity, 60,000 lb-per-hr two-hour peak, 650 psig, 750-F total steam temperature. Initial operation at 275 psig, 745 F. Feedwater temperature 220 F. Total heating surface 7405 sq ft. Boiler fired by natural gas or oil

Induced-draft fan, 1 — Fly Ash Arrestor Corp
48,000 cfm at 4 in. wg at peak load. Electric-motor drives—50 hp, 1200 rpm

Burners, 4 *Coppus Fanmix* — Coppus Engineering Corp

Recovery boiler, 1 — Combustion Engineering, Inc
165 ton-per-day capacity. Capable of burning 495,000 lb per day of dry solids. Design steam generation 61,500 lb per hr at 600 psig and 750-F total steam temperature. Initial operation at 61,500 lb per hr at 275 psig and 720-F total steam temperature. Generating capacity based on black-liquor higher heating value of 6500 Btu per lb of dry solids

Forced-draft fan, 1 — American Blower Corp
31,700 cfm of air at .10 in. wg. Electric-motor drive—75 hp, 1200 rpm

Induced-draft fan, 1 — American Blower Corp
68,200 cfm at 8 in. wg. Electric-motor drive—150 hp, 900 rpm

Cascade evaporator, 1 — D J Murry Manufacturing Co

Precipitator, 1 — Research-Cottrell, Inc
Electrostatic, wet-bottom unit. 52,600 cu ft per min of gas at 300 F and 95% removal of suspended matter present in inlet gases, with 0.05 grains per standard cu ft of gas at precipitator outlet

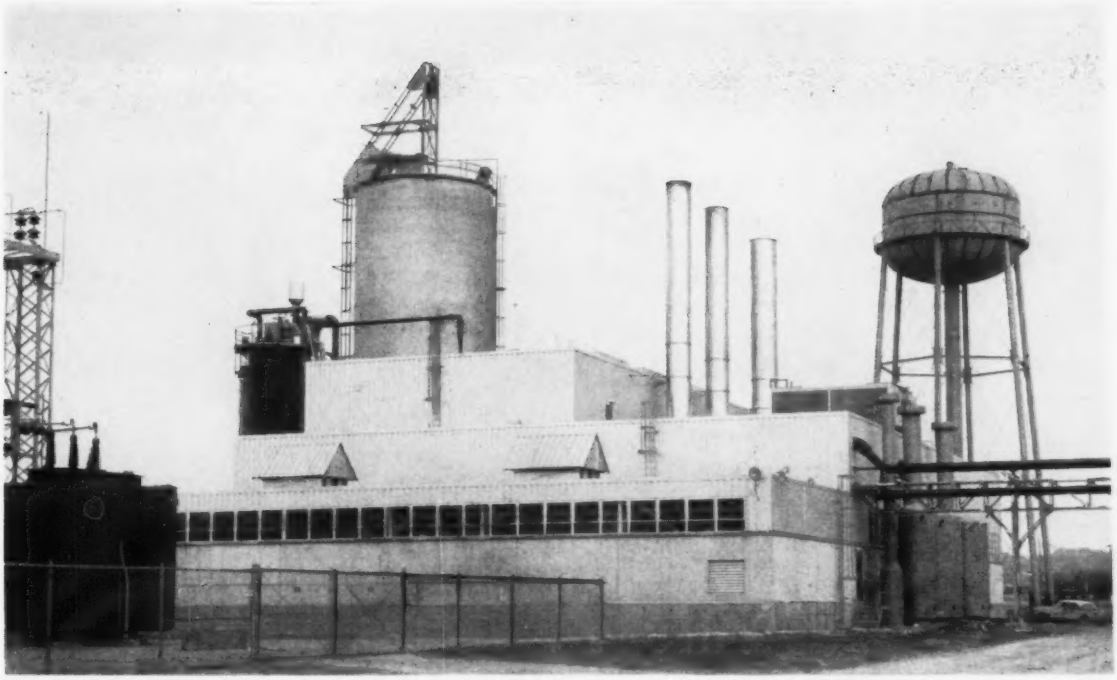
Boiler controls — Bailey Meter Co

Feedwater-treatment equipment — Graver Water Conditioning Co

Electric switchgear, 6 units — Westinghouse Electric Corp
13.8 kv, indoor, metalclad, 250-mva rating

Electric transformers, 9 — Westinghouse Electric Corp
1—2000 kva, 13.8/2.4 kv; 1—1000 kva, 13.8/2.4 kv; 2—1500 kva, 13,800/480 v; 2—1000 kva, 13,800/480 v; 3—750 kva, 13,800/480 v

Engineering and construction — The Rust Engineering Co



CENTRALIZED UTILITY BUILDING houses boilers, air compressors back to back, with boiler silos, air bottles outside. Outdoor substation feeds cable vault and switchgear room at end of building. Underground cables distribute power to plant proper

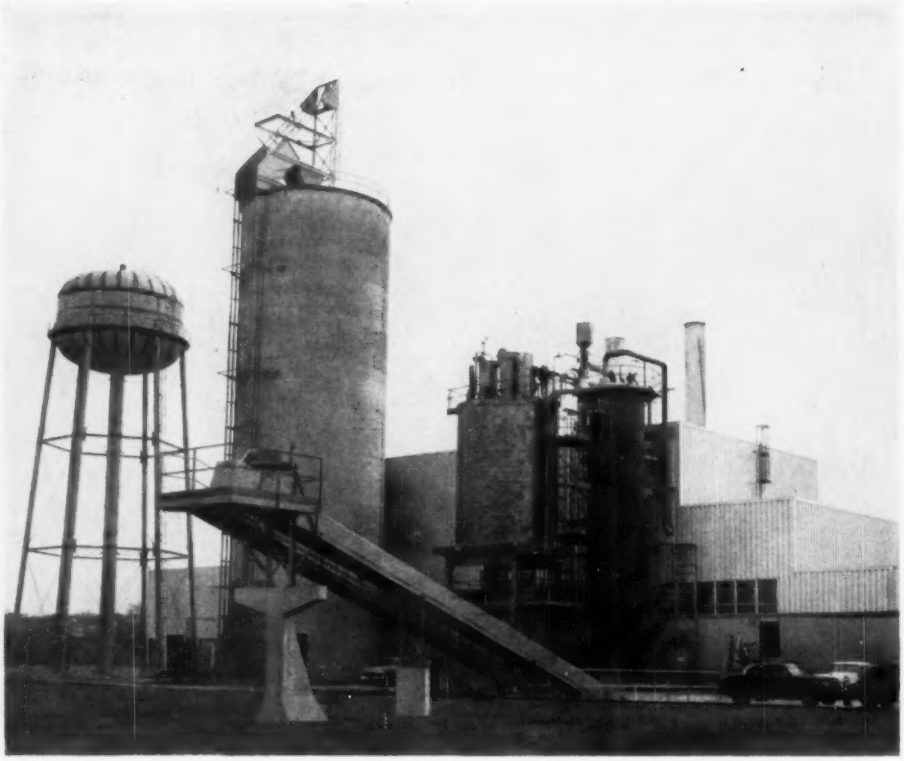
Compressed air is big business at Ford plant

Growth of automation, powered by compressed air, adds third major utility service to steam, electricity in Ohio plant

Compressed air today supplies much of the muscle for the automobile industry's automatic production lines. As plant air requirements skyrocket, power engineers have been forced to consider integration of this giant utility service into centralized power plants as a third major branch.

Ford Motor Co's new automatic-transmission plant at Sharonville, Ohio, is a top-flight example of a sensibly designed utility-services center. Here electricity for power, steam for heating and process, and air for automation share the power plant. Building size was kept down to a minimum but designers prepared for future growth of all utility needs. The boilers and compressors are back to back in a single unpartitioned area, with distribution switchgear for purchased power in a separate room across one end of the plant.

Air service is supplied by one 4200-cfm air compressor driven by an 800-hp 440-v synchronous motor, and two 8400-cfm compressors driven by 1750-hp 13,200-v synchronous motors. Compressor area has space and foundations for two more 8400-cfm units as a PTG feature. Inlets from above roof level bring air down to receivers outside the building. Air passes through filters just inside the building wall to suction bottles. From these, the air rises to first-stage cylinders which compress it to 28 psig and discharge it upward to intercoolers above the compressors. The cooled air passes down to the second-stage



PLANT AUXILIARIES fill area behind main building with coal and ash silos, skip hoist, water softener. Stocking-out conveyor, foreground, is served by track hopper. Bulldozers reclaim coal into main hopper

Outdoor coal storage and auxiliary receivers cut building size

cylinders and discharges at 110 psig through discharge bottles and aftercoolers to the outdoor receivers. Water for inter- and aftercoolers runs through a cooling tower on the roof above the compressors, and discharges to a collecting tank tucked away in the basement. From here it is recycled back to the cooling tower.

Electrical distribution system centers in the switchgear room beyond the boiler and compressor area. Beneath one part of the room is a large cable vault. Incoming utility power is transformed down to 13.8 kv in an outdoor substation a short distance from the building wall, and is carried underground to the cable vault, then up to bus bars above the distribution breakers on the operating floor. Power lines drop back to the vault and go through duct banks to the compressors and to the manufacturing area.

Transformers provide 440 v for the small compressor, the boiler auxiliaries and smaller motors, and 110 v for lighting in the power-plant area. The entire system has been engineered for future growth of the plant. Space has been left in the substation area for additional transformers and, as an added measure, transformer design allows fan cooling to be installed to boost ratings from 12,000 kva to 16,000 kva per transformer.

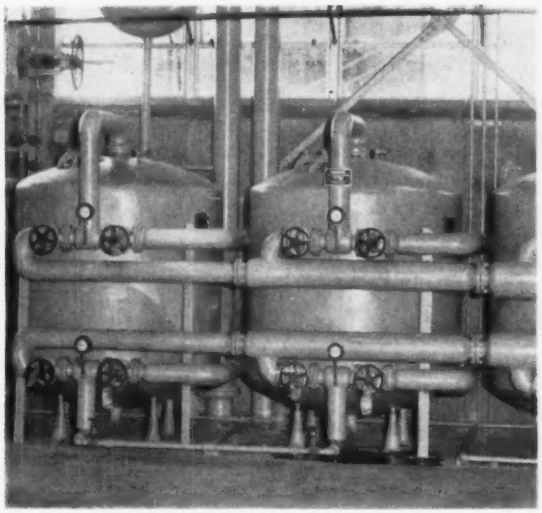
Underground cable ducts are designed to allow doubling number and size of cable leads to breakers. Thirteen feeder breakers are sized to carry original load, with room for four more breakers in existing cubicles and floor space allotted for four additional cubicles. Underground cable ducts to manufacturing areas are capable of accepting additional cables to balance added input to the power-plant switchgear.

Process-steam and heating load requirements are handled by three 125-psig boilers supplying saturated steam. Two units are 80,000 lb-per-hr capacity each with 440-v electric-driven auxiliaries. The third unit has 120,000 lb-per-hr capacity with dual steam-turbine and 440-v electric-driven auxiliaries. All are fired with coal on continuous-ash-discharge spreader stokers. All have air preheaters, dust collectors, forced- and induced-draft fans, individual steel stacks, full instrumentation and fully automatic controls.

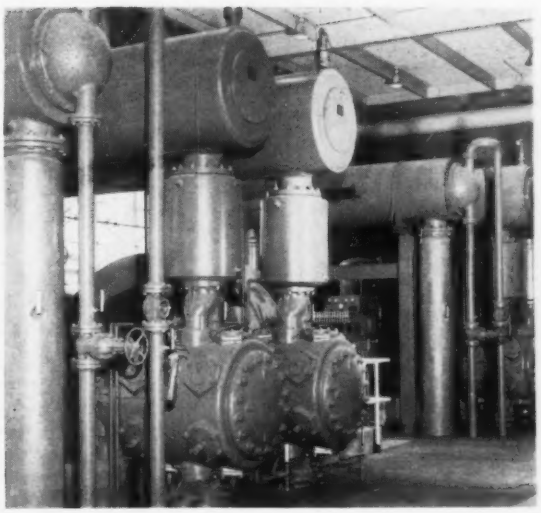
Power-plant cost was kept to an absolute minimum by installing many of the bulky structures outside the building proper. These included coal silo, skip hoist, ash silo, water softener and air bottles. Exterior design for these units allowed plant's roof line to follow the elevation of the three major utility units. All terminal handling of coal and ash occurs outside the main building.

Coal is unloaded from railroad cars

Main exhaust muffler Air-discharge Incoming power transformer



CHEMICAL TREATMENT equipment shoehorns into space at end of firing aisle and against wall. Softener tank is outside building



AIR COMPRESSORS in battery feed outdoor receiver bottles. Two additional compressors can go in-line to boost plant capacity

Principal power-plant equipment

Ford Motor Company, Sharonville, Ohio

Air compressors, 3 ——— Clark Bros Co
1—4200 cfm, 2—8400 cfm opposed compound, 35 and 22 in. by 14 in.

Compressor motors, 3 ——— Elliott Co
1—800 hp, 440 v, 300 rpm; 2—1750 hp, 13,200 v, 300 rpm

Air filters, 5 ——— Dollinger Corp

Cooling tower, 1 ——— J F Pritchard & Co
1200 gpm, 95 F to 85 F with 75-F wet bulb

Boilers, 3 ——— Erie City Iron Works
2—80,000 lb per hr, 90,000 lb-per-hr peak; 1—120,000 lb per hr, 138,000 lb-per-hr peak; all boilers—160-psig saturated steam

Stokers, 3 ——— Hoffman Combustion Engineering Co
Continuous ash-discharge spreader

Dust collectors, 3 ——— Green Fuel Economizer Co, Inc

F-d, i-d-fans ——— Westinghouse Electric Corp, Sturtevant Div
Electric drives—Reliance Electric & Engineering Co; Turbine drives, 120,000 lb-per-hr boiler only—Terry Steam Turbine Co

Instruments and combustion control ——— The Hays Corp

Coal-handling equipment ——— Fairfield Engineering Co

Pneumatic ash-handling equipment ——— Allen-Sherman-Hoff Co

Water softener ——— Graver Water Conditioning Co
Hot-process lime-soda, 70,000-lb makeup capacity; filters; integral deaerator

Boiler-feed pumps, 3 ——— Ingersoll-Rand Co
2—350 gpm, 188 psig; 1—150 gpm, 188 psig

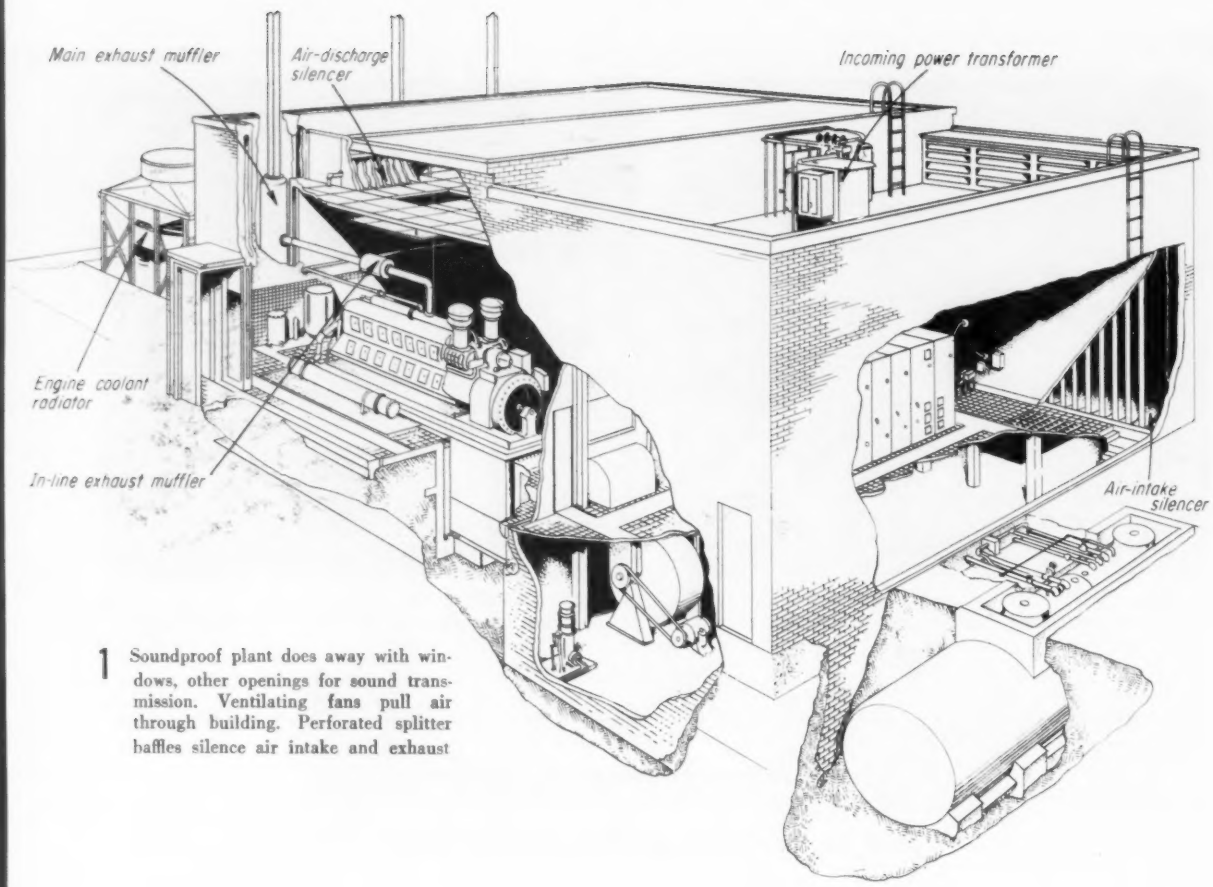
Substation transformers, 2 ——— General Electric Co
Rating—12,000 kva, 60 cycle, 3 ph, oil filled, 66,000/13,200 v

Switchgear, 15 ——— General Electric Co
15,000-v air circuit breakers, 500-mva interrupting rating

Engineering and construction ——— The Rust Engineering Co

or trucks into a track hopper. It passes through a crusher and is raised to the top of the coal silo by a skip hoist. Coal in the silo rests on a sloping concrete bottom, and feeds by gravity through a chute in the building wall to a weigh-larry running the length of the firing aisle. Ashes discharge forward to brick-lined concrete pits. A pneumatic system moves ash from pits and fine flyash from the dust collectors to a dustless unloader on the outdoor ash silo. Coarse flyash is reinjected into the backs of the furnaces to reduce boiler carbon loss. Boiler auxiliaries are clustered in the area between the boilers and air compressors. Air heaters and dust collectors are overhead, forced- and induced-draft fans and drives are at operating level, and the reinjection system is below in an open pit for easy access. The three stacks rise vertically from the induced draft-fans to save the maximum amount of space.

Chemical treatment equipment is installed at the end of the firing aisle. The water-treatment chemical tanks, filters and backwash pump serve an outdoor lime-soda hot-process, deaerating type water softener. Chemical pumps for the softener and for direct injection of phosphate to drums are on a level below the water-treatment chemical tanks. Water-softener tank is outside the building.



1 Soundproof plant does away with windows, other openings for sound transmission. Ventilating fans pull air through building. Perforated splitter baffles silence air intake and exhaust

General Motors' soundproofed plant turns

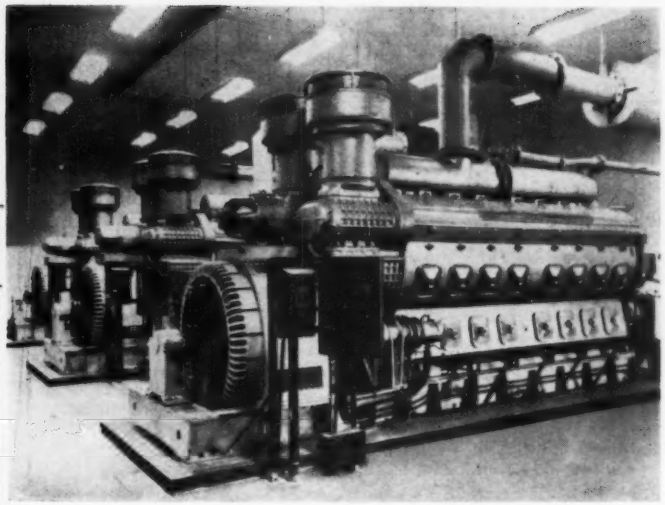
General Motors engineers point with pride to their soundproof diesel generator plant near São Paulo, Brazil. This power plant is unique because the effects of noise on employees and plant neighbors were primary considerations in powerhouse design. Factory offices and densely populated areas of São Caetano, a suburb of São Paulo, surround the power-plant grounds. Foresight on the part of GM design engineers and the acoustic engineering firm has paid off handsomely, since no complaints of noise have been received from nearby neighbors or personnel in the adjacent GM plant offices. These power men now feel many of the usual limitations on use of diesel-generator sets in populated areas can be canceled by good acoustic design.

Designers' goal was a diesel-generator power plant which would not disturb persons in the general area. Open windows usually are a major avenue for noise escape, so engineers decided on a windowless structure. This construction dictated a mechanical ventilation system large enough to supply ventilation and combustion-air needs for all three units.

Generating equipment consists of three 1000-kw units driven by 1440-hp diesel engines. Space for a fourth unit provides future growth potential. Each engine needed 5000 cfm of air for combustion and cylinder scavenging. An extra 10,000 cfm per generator was needed to maintain comfortable engine-room temperatures. This required one 15,000-cfm blower per generator, so three units were installed, with floor space left for a fourth.

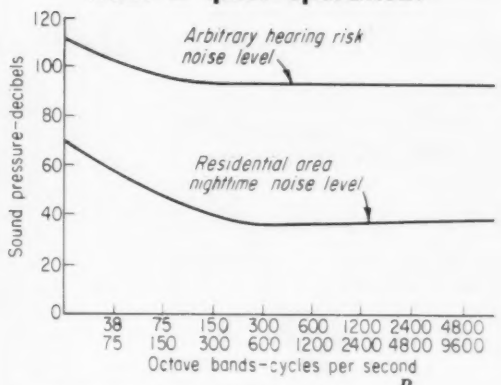
Air requirements for the generators gave acoustical engineers design figures for a silencing system to handle 60,000 cfm at air intake. Flow through air-exhaust silencer was set at 40,000 cfm. Air flow for the proposed fourth unit was not included in design of the present system.

At this point, engineers set their sound-level goals and determined which avenues of sound transmission would require special handling. As a first step, GM furnished sound-level data for the diesel sets and test readings of noise in plant's neighborhood. Curves of noise level are plotted in Fig 6. Acoustical engineers listed nine channels through which noise escapes to the outside: (1) building air-intake openings (2) building air-exhaust openings (3) hot-gas exhaust system (4) building walls (5) building roof (6) building floor (7) diesel-engine foundations (8) doors (9) other openings such as water pipes,



2 Diesel generators supply power for GM manufacturing plant in Brazil. Generator room contains three 1000-kw units with space for a fourth. Acoustical engineers designed generator room for minimum noise transmission, maximum noise absorption. Engine foundations float on cork mats to reduce noise transmission. Generator room ceiling is acoustic baffle with dropped section over generator sets. Acoustic ceiling cuts noise level in generator room to improve operating conditions for power-plant personnel. Ventilation air exhausts to plenum chamber above dropped panel and then out through exhaust-silencer splitter baffle mounted at the end of the building

What is quiet operation?



Sound pressure level $(SPL)=20 \log \frac{P}{100.002}$

P is sound pressure measured in dynes per sq cm
Sound power level $(PWL)=SPL+10 \ln A$
A is surface area of envelope where pressure SPL exists

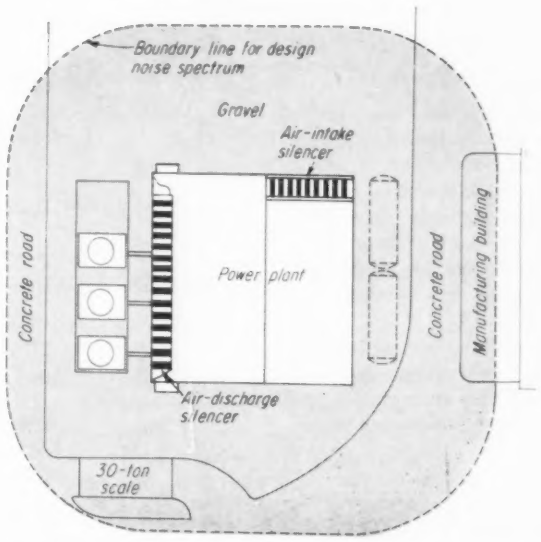
At any given distance from source, noise, as it affects the human ear, is expressed in decibels as sound pressure level. Sound power level, also in decibels, represents total noise generated by a source. Frequency of sound changes its effect on the human ear, with lower frequencies less disturbing. Curves above show upper and lower limits of most sound we hear. Narrow range between hearing-risk noise and normal quiet means sound attenuation of one decibel is noticeable

diesel generators into quiet neighbors

electric conduits, etc. Design of the entire power plant was to be arranged so that noise of generator sets could not be heard 50 ft from plant walls. Engineers drew the map shown in Fig. 3 to indicate boundary limits for silencing.

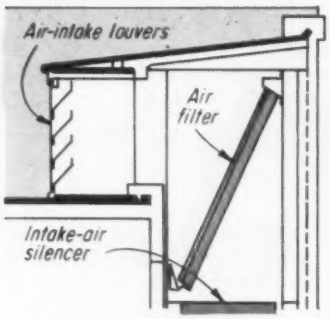
Air-intake silencers mount in a duct behind the switchgear-room wall. Air flows through louvers, air filter and silencing system consisting of 8-in. splitters of perforated baffle. Flow is ducted into the blower room and discharges into the generator room along the switchgear wall. Fan-room noise is high although blowers contribute little to overall level.

Ventilation air passes through openings in a suspended acoustical ceiling into a plenum chamber. Air finally exhausts through an acoustic splitter system much like the inlet-air system. Exhaust gases discharge

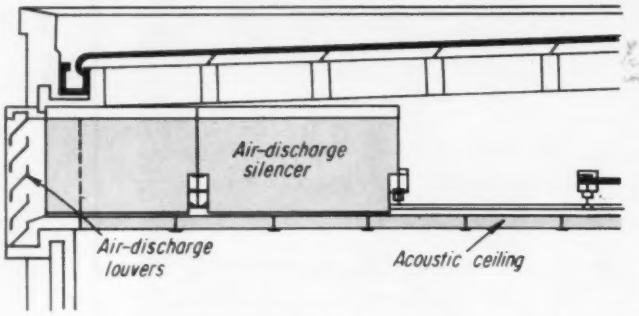


3 Noise limit for the plant required noise reduction down to ambient sound level when 50 ft from building in any direction

Acoustic filters cut air transmission of diesel-unit noise, while



4 Air-intake section includes louvers, filter and splitters in duct to fan room



5 Air-exhaust silencer at exit of plenum chamber uses splitter to reduce noise. Acoustic ceiling hangs from rubber-mounted steel channels and bars

through in-line mufflers in series with high-efficiency exhaust mufflers supplied with the diesels. In-line mufflers reduce noise more than regular mufflers only. Main exhaust mufflers rest on individual foundations outside building.

Sound passage through plant walls is stopped cold by the double brick wall. A single wall would have done a satisfactory job, but engineers added second wall to conceal piping and steel structure.

Building roof was constructed of 4-in. thick precast concrete slabs, this thickness dictated by acoustical considerations rather than load. In addition to roof, the acoustic metal-panel ceiling is suspended from roof I-beams by rods and rubber bushings. Space between forms the exhaust-air plenum chamber.

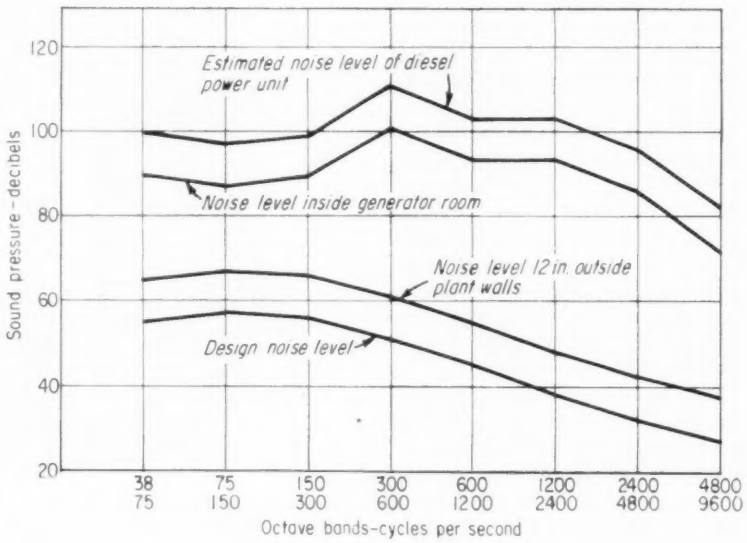
Diesel-generator sets are major noise sources, so engine foundations were designed to prevent structural noise transmission. Basically, foundation is a solid concrete block three times diesel-generator's mass. Concrete block rests on 3-in.-thick cork mats surrounded by a waterproof concrete cradle.

Plant doors are special soundproof construction, with vestibule and double doors. This arrangement prevents noise transmission when people go in or out of building. Concrete floor is separated from building wall by cork strip to isolate vibrations.

Sound-absorbing ceiling was intended as noise-abatement measure for operating personnel inside generator room. Operators report the acoustic ceiling cuts overall noise level as compared with plants lacking sound-absorbing treatment. Noise curve in Fig. 6 indicates effects of acoustic ceiling on measured noise.

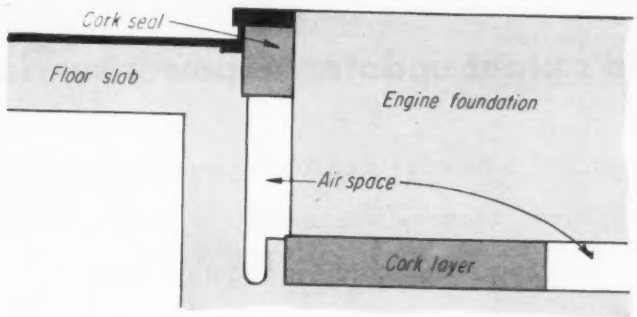
Silencing effect outside building was carefully checked by GM engineers at the plant. Test engineers from General Motors do Brasil recorded noise levels directly outside and some distance away for several 24-hr periods. Test reading results 12 in. outside plant wall are shown as average curve in Fig. 6. Readings taken 50 ft from plant showed ambient noise level of the area was generally higher than sound of power plant.

Direct observation, "listening by ear," in populated area near plan indicated normal street traffic was louder than powerhouse noise even at night. On rare occasions when everything else was dead quiet, only a faint hum was thought to be heard.

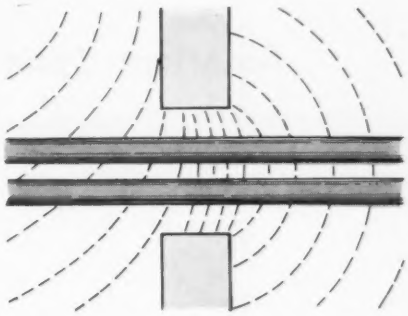


6 Successful silencing reduced sound level outside building to required value. Generator-room acoustical ceiling resulted in lower noise level for operators

massive concrete foundation, cork mats do same job for vibration



7 Engine-foundation block absorbs much of diesel's vibration in its mass. Asphalt-coated cork cuts sound transmission from block in all directions



8 Noise leaks such as this are avoided by careful design, treatment of openings

Soundproofing this entire plant was admittedly expensive, but effect on plant community relations was invaluable. The overall silencing job achieved maximum effect because all details were attended to from sealing around doors to blocking openings for passage of conduit or pipe. The reason for this fine detail work is partially explained in Fig. 8, which shows the result of just one hole in the noise barrier. Interior sound waves pour through small openings with very little loss of volume, slight change in frequency. Noise reradiates from the openings as a new sound source. Water lines, electric conduit and other pipes at the GM plant had rubber snubbers installed to damp out vibration.

Actual cause of diesel noise has never been thoroughly understood until the last few years. A lot of test work has been done by Navy engineers on the overall problem since silencing systems of this type could not be used on shipboard.

Naval Material Laboratory experts analysed diesel-generator noise sources in a paper submitted to 27th Conference of Oil and Gas Power Div, ASME. Test engineers ran a Naval diesel unit in a special sound-measurement booth and recorded noise levels under differing operating conditions. Test engine was driven by electric motor, stripped of components in steps to isolate noise sources.

Operating checks indicate diesel noise increases with speed, is independent of load. Fuel combustion does not add to noise level since engine generated as much sound when motor-driven as when driving.

Basic noise sources included: (1) scavenging blower (2) pistons and rods (3) exhaust valves (4) injectors (5) lubricating-oil pump (6) cooling-water pumps. Scavenging blower accounted for a major part of total noise; sound radiated from blower-intake opening and from flat surface of engine air box. Pistons and connecting rods contributed a large noise source because of large masses involved. High stress of rotating weights and pistons on other parts created sound vibrations in whole structure.

Exhaust valves are noise makers of secondary importance. Valve tappets are minor source compared to noise of valve seating. Cam-rocker mechanism of injectors triggers hydraulic shock waves which transmit through cylinder head. Lubricating-oil pump generates noise similar to other gear pumps, cooling-water pumps contribute little to overall noise level.

Principal power-plant equipment

General Motors Corporation do Brasil, Sao Caetano, Brazil

Diesel-generator units, 3—General Motors Corp, Cleveland Diesel Engine Div
Electric generators, 3—Elliott Co
1250 kva, 0.8 pf 1000 kw, 4160 v, 3 ph, 60 cycle, operated at 3800 v
Diesel engines, 3—General Motors Corp, Electro-Motive Div
1440 hp, 16 cylinder, 720 rpm, 567 cu in. per cylinder, 2 cycle
Exhaust silencers—Maxim Silencer Co
10,000-cfm resonators
Air intake, exhaust silencers, 1 each—Industrial Acoustics Co, Inc
Perforated metal and fibre-blanket baffles
Cooling-water towers, 3—Young Radiator Co
Dry type horizontal radiators rated 2765 k Btu-per hr. Air fans, one per tower, rated 15,000 cfm
Electrical switchgear—Westinghouse Electric Corp
Transformer, 1—Westinghouse Electric Corp
Auto-transformer, 3800 v regulated
Acoustical design consultants—Industrial Acoustics Co, Inc

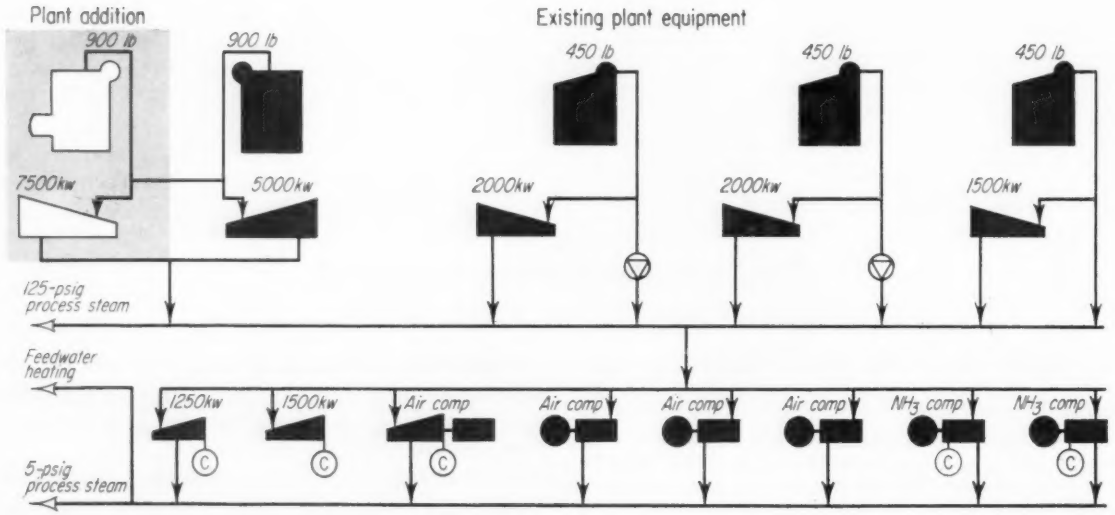
American Cyanamid's plant updates its power services

More process steam — Plant steam requirements equaled generating capability, so additional capacity was needed to insure reliability of service, reduce load on older steam generators

lore electrical distribution — Increased process load plus electrical needs of planned activated-sludge waste-treatment plant required greater generating and distributing capacity

More treated water — Existing zeolite water-treatment equipment would not be able to handle increased feedwater and process-water use. Existing water heaters would be overtaxed by extra boiler

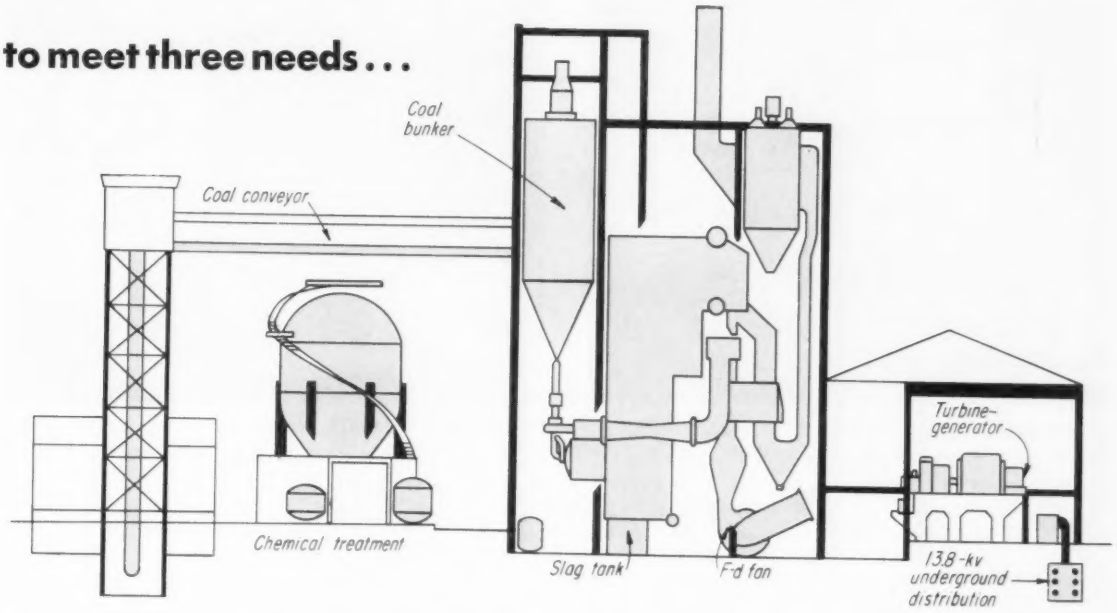
Bound Brook puts PLAN '59 in action



ADDED POWER SERVICES give needed boost to process-steam, electrical-generation supply. New steam generator, noncondensing turbine tie in with existing high-pressure unit for reliability. Condensing turbines, compressors supply condensate return

AMERICAN CYANAMID continued

to meet three needs . . .



POWER-PLANT ADDITION includes cyclone steam generator in extension of existing boiler house. New feedwater-treatment system serves as feed heater and deaerator. New generator unit supplies the underground 13.8-kv distribution lines to effluent plant

to modernize, prepare for future growth

American Cyanamid's utility engineers are no strangers to expansion problems. Bound Brook, N. J. has grown through the years and its power services have grown with it and modernized as engineering advances were incorporated.

Briefly, Bound Brook's utility section handles just about every type of power service somewhere within the plant. From inception, all electric power used has been generated in-plant. There is no public utility tie-in, so equipment reliability is of the greatest importance. In event of complete power-plant shutdown, diesel-generator units are set to supply power for plant startup.

Chemical industry is a big user of process steam and Bound Brook's needs are such that the majority of electrical-generating equipment consists of noncondensing turbines. This calls for delicate balancing of process- and heating-steam requirements against electrical load.

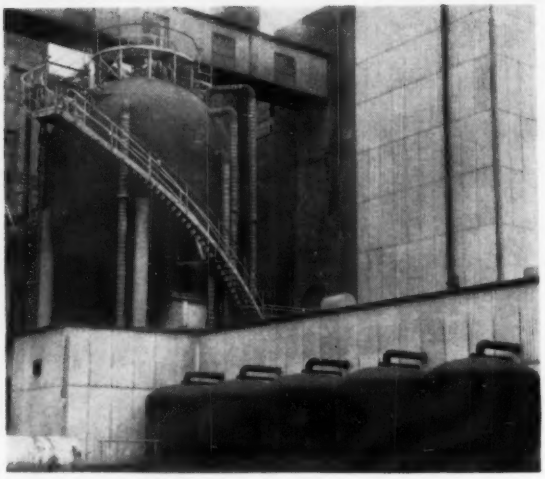
Besides steam and electricity, power-services men supply manufacturing sections with compressed air, flake ice and compressed ammonia for process refrigeration, cooling water, treated process water, air conditioning.

A major concern of the utility services is plant waste treatment, with 20 million gpd of water used and returned to the Raritan River. All effluent receives extensive treatment to remove organic, inorganic wastes.

Before their recent plant expansion, utility engineers were faced with a tight power supply and demand picture. Saving grace in this situation rested with the superb job Bound Brook's utility men have always done in maintaining equipment in peak operating condition. Records over the years show equipment availability higher than for many public utilities. Solution called for installing a new high-pressure steam generator and topping turbine so load on less efficient units could be reduced.

Power-to-grow, *circa* 1917, kept expansion costs to a minimum. Designers of original power plant planned for an extensive utilities department with complete independence from the local public utility. The space allowance has slowly been used up by increases in power services, but latest turbine installed in plant was able to fit in an unused area of old turbine bay. New building construction consisted of addition to boiler bay and a small

TURBINE-GENERATOR is installed at end of plant turbine bay. Noncondensing turbine matches steam conditions of older turbine



FEEDWATER-TREATMENT system consists of hot lime-zeolite process. New system is sized to handle 100% makeup for plant

structure to house new feedwater-treatment equipment and controls.

Steam generator was selected to match operating conditions of existing 900-psig boiler-turbine unit since new unit would tie in with h-p header. This tie-in was designed to give maximum reliability to h-p system which generates 56% of total plant capacity.

New boiler fires bituminous coal in cyclone furnace. Coal burned in cyclone also has been successfully burned on older units' anthracite stokers. Bituminous can be burned merely by modifying operating procedure, so switch between fuels can be made as conditions warrant.

Choice of high-Btu low-ash coal was easily justified. With transportation costs making up a large percentage of fuel price, the premium for high-grade coal is offset by increased steam generation per ton of coal.

Boiler was designed as single-cyclone slag-tap unit with pressurized furnace. Combination of pressurized firing and cyclone furnace saved building space and operating costs for fans and combustion-equipment drives. Overall unit layout makes most efficient use of space for auxiliaries by arranging fan, air preheater and economizer below boiler convection bank. Precipitator location keeps building width within limits of old boiler house.

Designers chose an electrostatic precipitator to further reduce already low stack discharge resulting from slag-tap unit. Community relations and product purity demanded low dust loading in gases leaving stack. A hydraulic ash-handling system transports accumulated ash from precipitator and boiler hoppers, and slag sluices from refractory-lined slag tank for automatic handling.

Boiler controls are not centralized because of header system. However, unit has fully automatic combustion and auxiliary controls centrally mounted at firing aisle.

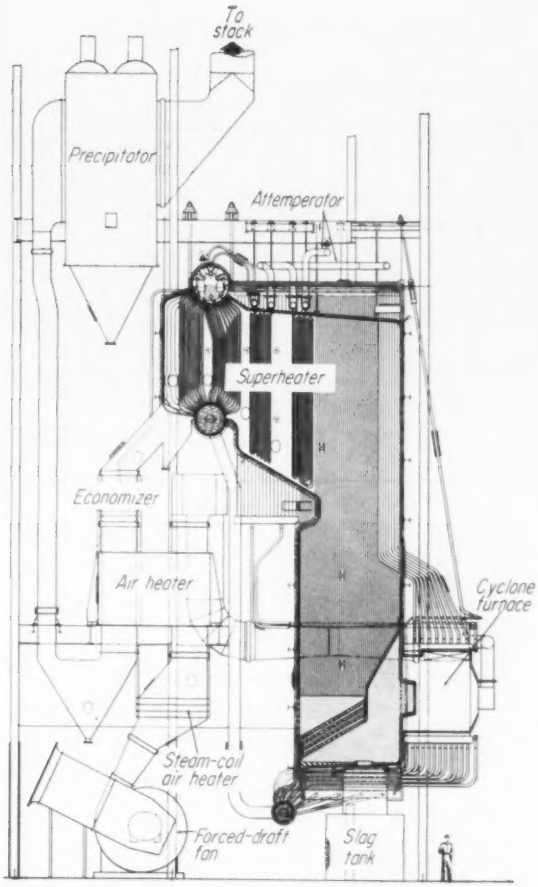
Turbine-generator is installed at end of the old turbine bay. Topping unit is of conventional air-cooled design, generating at 13.8 kv and exhausting at 125 psig to the l-p header system. A unit control board for all turbine and generator controls faces turbine throttle end.

Electrical distribution is at 13.8 kv from generator to load centers in plant. Generator leads go to cable vault directly below turbine's operating deck, and drop to underground utility tunnels for distribution to new effluent plant. Underground tunnels are used for distribution of h-p and l-p steam, process water, compressed air and most electrical power. Existing manufacturing-plant distribution was at 2400 v, but all replacement of equipment from now on will be with 13.8-kv units.

Distribution lines to effluent plant at 13.8 kv run underground through the manufacturing plant and rise to distribution towers for the remaining distance. Secondary load center at the effluent plant steps down voltage to 2300 v and lower. The effluent plant represents a large block of constant power demand. Two 2500-cfm centrifugal blowers and a large number of pumps operate constantly. Other big power users, such as river-water pumps, operate off existing 2400-v lines in main distribution grid.

Feedwater treatment for the entire power plant is sized for 100% makeup. High installation costs and operating problems argue against use of condensate-return systems for a large plant with widespread process-steam requirements. Basically, the only return is from condensing machines, heaters in power plant.

Before the latest plant expansion, feedwater-treatment equipment was also supplying treated water to the manufacturing plant. Addition of the new boiler would have pushed this treatment system beyond its capacity. To solve this problem, design engineers installed a new hot lime-zeolite softening system to supply water for the five steam generators. The old water-treatment system was arranged to handle process-water requirements with a solids concentration of six to eight ppm. New system has a rated flow of 1400 gpm, enough to handle present total feedwater needs with no condensate return. Zeolite softener for manufacturing-plant process water is rated



STEAM GENERATOR fires bituminous coal in cyclone furnace. Pressurized-furnace unit operates with a single forced-draft fan

Principal power-plant equipment

American Cyanamid Co, Bound Brook, N. J.

Turbine-generator, 1 ——— Westinghouse Electric Corp
9375-kva capability, 13,800 v, 3 ph, 60 cycle, 7500 kw at 0.8-pf capacity, 3600 rpm, 860 psig, 820 F, 125-psig exhaust pressure, noncondensing unit, air cooled

Steam generator, 1 ——— Babcock and Wilcox Co
2-drum watertube Stirling, 200,000 lb per hr continuous, 215,000 lb per hr 2-hr peak, 825 F, 865 psig, single cyclone furnace, pendent superheater, slag-type furnace for pressurized firing at 10 in. wg

Air preheater, 1 ——— Air Preheater Corp
Ljungstrom regenerative, vertical-shaft unit

Forced-draft fan, 1 ——— Westinghouse Electric Corp, Sturtevant Div
Net req 269,000 lb per hr of air at 58.1-in. wg, 80 F

Forced-draft fan drive, 1 ——— Allis-Chalmers Mfg Co
1250-hp electric drive, 1760 rpm

Soot blowers, 14 ——— Diamond Power Specialty Corp

Ash-handling system ——— United Conveyor Corp

Slag tank, 1 ——— Allen-Sherman-Hoff Co

Boiler-feed pump, 1 ——— Worthington Corp

Combustion-control system ——— Bailey Meter Co

Feedwater treatment system ——— Graver Water Conditioning Co
Hot lime-zeolite system, 1900 gpm rated capacity; reactor, deaerator, *Anthrafilt* filters, zeolite tanks

Dust collector, 1 ——— Research-Cottrell Corp
Electrostatic unit, 205,000 lb per hr gas at 268 F

Primary distribution, underground cable ——— Okonite Co
Cables, 2400 and 13,800 v

Secondary substations ——— Westinghouse Electric Corp
Two 7500 kva, 13,800/2300 v, oil type transformers

Secondary substations ——— Allis-Chalmers Mfg Co
One 2000-kva, 13,800/2300 v, oil type transformer
One 500-kva, 13,800/400 v, oil type transformer

Engineering and construction ——— Ebasco Services Inc

at 3000 gpm. This actually allows a good margin of safety and room for expanding water needs within plant power and process areas.

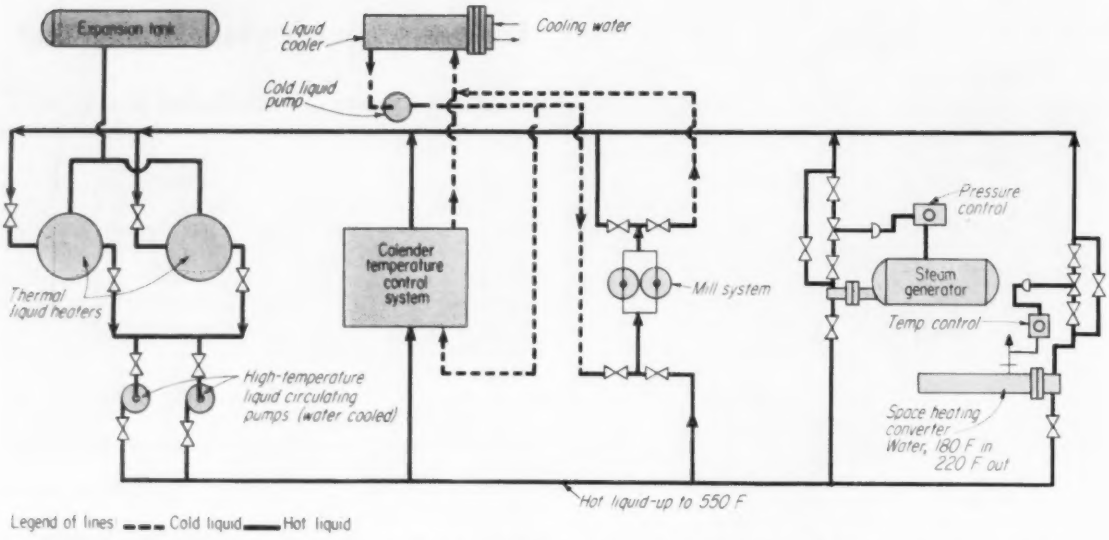
Feedwater heaters for the plant were just able to carry load of existing four units, would have required extra units to handle new load. However, selection of hot-lime system solved that problem since softener supplies 220-F water to heaters. Economizer-inlet temperature for all five units is 230 F, so existing heaters are required to raise water temperature only ten degrees.

Feedwater-treatment system is housed in tanks and a structure behind the new boiler bay. It consists of hot-lime reactor, five filter tanks, four zeolite beds, chemical-mixing tanks, pumping and back-washing equipment.

All power services at Bound Brook are sizable and complex, but actually are handled at a moderate cost in process steam and electrical power. Ammonia refrigeration runs over 500 tons for direct process use, with another 540 tons going for flake-ice manufacture. Incoming river water flows through ammonia condensers before entering plant's water system. In addition, five deep wells supply process water at about 55 F for spray cooling-tower makeup and special use. Before entering the main water-supply system this well water runs through cooling coils of building air conditioning to supply cooling for 1000 tons of refrigeration. River water also cools 14,700 cfm of compressed air to be distributed throughout the plant.

Although these services would, by themselves, add up to a large utility job in any plant, the process-water and waste systems at Bound Brook are as big again. Plant has always maintained extensive waste-treatment facilities. Plant wastes come from 800 different chemical operations in which company uses and returns approximately twenty million gpd of river water.

Waste treatment includes chemical neutralization of liquids as they enter large settling basins. Sludge is removed from these areas for complete oxidation and final disposal by the new 4-acre effluent plant. When liquid is pumped to the Raritan River it is actually purer than intake water to the plant, another item in American Cyanamid's policy of being a good neighbor.



THERMAL LIQUID at temperatures up to 550 F, delivered by two 3-million Btu-per-hr heat generators, supplies plant's process and space-heating needs. Calender temperature control has an intricate valving system, recirculating pumps in circuits

Kayetex goes all out for thermal-liquid system

Immediately following World War II, there was a growing need in various industrial processes, particularly in the field of plastics processing, for better methods of supplying heat energy and controlling temperatures. The need was especially pressing in calendering, where higher speeds involved called for cooling to hold roll temperatures constant. Cooling would not only remove friction-generated heat but would permit quick changes in roll temperatures to keep in balance with different stock runs or changes in calender speed.

Hydrotherm high-temperature water systems were developed to supply plastic-processing temperature-control needs, and the industry went for h-t water in a big way. Supplanting steam heating, the h-t water system with its automatic controls provided the smooth transition between heating and cooling obtainable only with liquids.

High-temperature water systems for vinyl-plastic calenders have generally been operated between 300 and 400 F, well within the limits of 150-psig steam. But temperatures up to 400 F are needed more frequently now, and this calls for steam pressures up to 250 psig to heat the water. These high pressures tend to aggravate flexible-hose and rotary-joint maintenance problems.

Faced with still higher temperature needs—for which neither steam nor h-t water is practical—the plastics-calendering industry is moving to use of heat-transfer media known as thermal liquids. These are synthetic or petroleum-base fluids for either vapor or liquid phase applications. They provide temperatures up to 600 F with operating pressures at or slightly above atmospheric.

Pioneering in this trend is the Kayetex Manufacturing Corp in Yardville, N. J., custom manufacturers of many types of plastic film and sheeting. In keeping with their custom manufacturing policy, Kayetex saw the need for higher process temperatures and installed a Hydrotherm thermal liquid system to serve its entire high-temperature process and space-heating needs.

Designed and constructed by American Hydrotherm Corp of Long Island City, N. Y., the system delivers the heated liquid (*Mobiltherm 600*) throughout the plant, see flow diagram, above. In addition to the plastics-processing equipment, the liquid serves heat exchangers to produce 220-F water for space heating and 250-psig steam for a rotocure. A cooling water circuit is integrated with the system to give pin-point control of process temperatures.

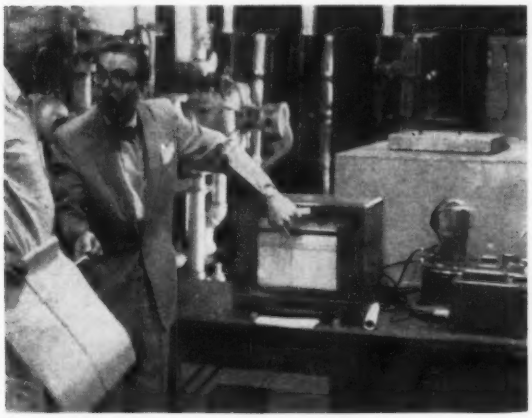
Calender-roll temperature control is through pneumatically actuated instruments which modulate heating or cooling pneumatic control valves. These valves inject hot or cooled liquid as needed into the circuit to hold desired roll temperature constant within one or two deg F. A recirculating pump in each temperature-control circuit holds high-temperature uniformity across the roll surface.

Two Cleaver-Brooks heat generators, each delivering 3-million Btu per hr, are in service at present. Plans call for doubling plant capacity. Cast-steel water-cooled circulating pumps near the heaters deliver the h-t thermal liquid to the system.

Automatic water analysis shows promise

Automatic water testing is the key to fully automatic operation of today's complex water-treating systems. With an accurate, reliable automatic analyzer, condensate, cooling and process water can be closely watched for iron and copper, and other troublesome impurities. Water from ion exchangers in demineralizing plants can be checked continuously to pinpoint unit capacity between regenerations and spot operating troubles.

Completely automatic analyzer system, below, was recently introduced by Technicon Controls, Inc., Chauncey, N. Y. Flow of water samples and reagents is from right to left. Sampler handles up to 60 samples/hr for batch analyses. If samples are taken continuously from a flowing stream, tubing delivers them directly to the proportioning pump. This special unit meters samples and reagents and sends them through the system in flexible tubing. Air slugs, taken in through open-ended tubing, separate samples, prevent backmixing and keep inner tube surfaces clean.



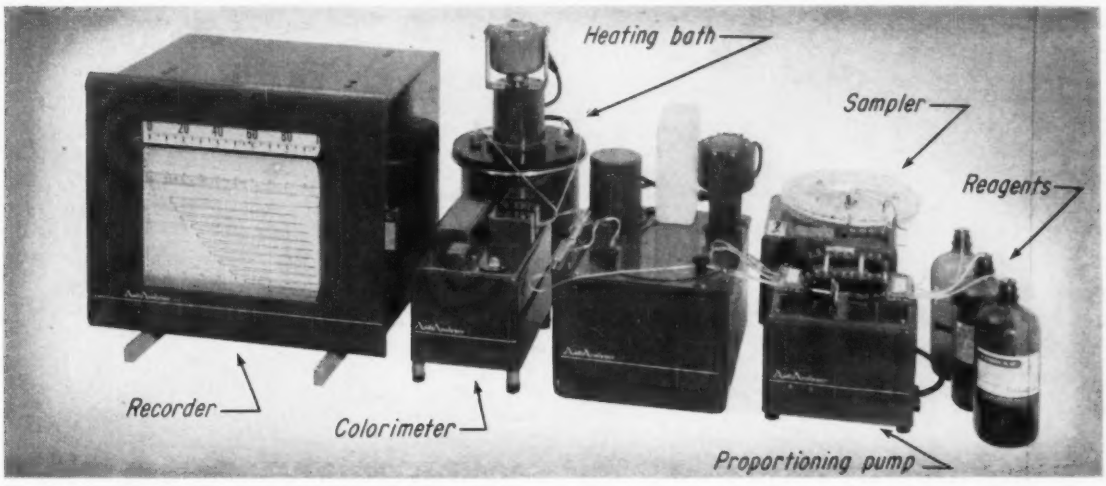
RECORDER at tail end of automatic analyzing system keeps track of any sugar contamination in condensate returns from evaporators

Sample and reagent streams both enter the dialyzer where diffusible chemicals in sample enter reagent stream through a semipermeable membrane. Sample stream containing nondiffusibles is sent to waste. Remaining reagent stream is mixed by passing it through a horizontal helical glass tube. Reaction temperature can be controlled by passing the stream through a coil immersed in a constant-temperature controlled heating bath.

Finally, concentration of the sample stream is measured in a ratio-recording colorimeter. Result is fed to recorder and is available for feedback control. Trace materials down to ppb can be accurately detected.

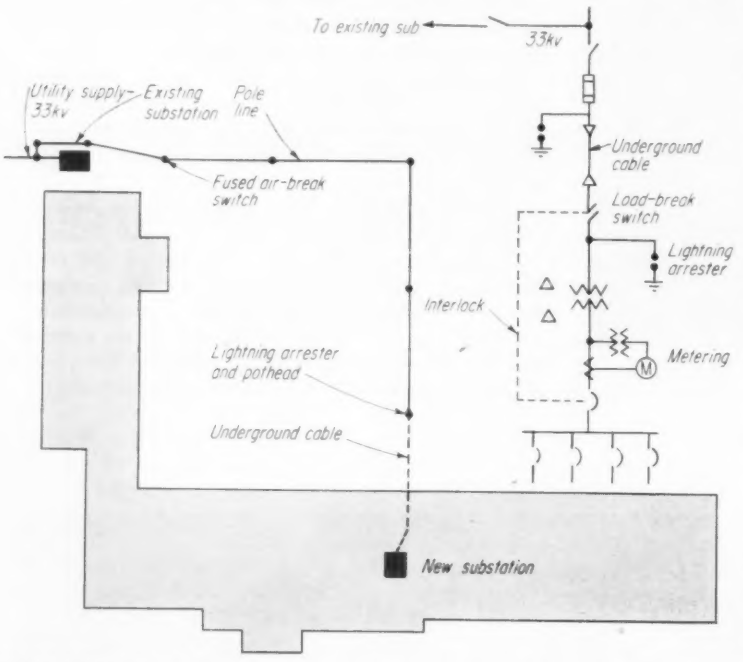
Initial cost varies from $3200 for the simplest arrangement to $12,000 for a more complicated setup capable of recording four different variables at once.

One of the pioneer installations for water analysis is at Flo-Sweet Products Corp. Yonkers, N. Y. If condensate returns from their sugar evaporators contain sugar, foaming and priming take place in boiler. Resulting carryover damages the steam turbines. Usual testing routines are time consuming and don't spot contamination soon enough to prevent trouble. So condensate is now continuously checked for sugar with an automatic analyzer, left. They plan to tie-in automatic dump valves to keep contaminated water away from the boiler.



AUTOMATIC ANALYZER, *above,* has six basic elements. Flow of water samples and reagents is from right to left. Each sample is compared with control sample in colorimeter. Resulting signal is fed to recorder at left and can be used for feedback control

33-KV SUBSTATION is housed in concrete vault in plant's basement. Louvered air intake is at right; exhaust duct at the left. Disconnect switch is operated from outside



PLANT LAYOUT makes long secondary feeders impractical. Pole line in yard carries high voltage close to building; an underground cable run takes it to sub at load center

33-kv substation comes indoors

When you're faced with the alternatives of running long secondary feeders from an outdoor substation or distributing at an intermediate voltage and using a secondary substation at the load center, a third choice may be available. That is to bring the outdoor substation inside the plant to the load center. That's what the engineers at Superior Tube Company, Collegeville, Pa., did. Their new 1500-kva substation, which transforms 33 kv to 480 v, is located at the center building wing, which will make expansion in several directions convenient. The plant is in the process of adding 35,000 sq ft of factory space and a new office building.

Power at 33 kv comes from the utility's lines near an existing outdoor substation and is brought to the building by a pole line in the yard. There's a fused disconnect switch on the pole near the beginning of this line, and lightning arresters on pole near plant where potheads are located for transition to cable. Cable is 4/0 3-conductor, paper insulated and lead covered. It runs through 5-in. steel conduit on pole to ground, through 5-in. transite conduit encased in concrete underground to substation vault. There's an outdoor type loadbreak switch mounted on ceiling of the vault, operated from outside the vault. Air-magnetic draw-out circuit breakers are used on 480-v secondary. Main breaker is rated 2000 amps (75,000 amps interrupting current). Metering is on secondary.

Big objections to indoor subs are cost and complications of meeting safety requirements for indoor oil-filled transformers and h-v distribution. Superior Tube found that with plant layout such as theirs it was economical. The cable was specially designed for the job. Superior's engineering department designed and built a special concrete vault to house the three 500-kva single-phase transformers. Cooling air flows into vault through a screened, hooded opening in one wall and then out through a similar opening in the opposite wall into a duct to the roof. Fire louvers with heavy metal slats are installed in the ventilating openings. They're held open by a chain, one link of which is made of metal with a low melting point; if fire breaks out, fusible links melt, closing louvers and shutting off air supply, thus extinguishing the fire. The vault was constructed to meet NEC requirements, and has been approved by Philadelphia Electric Company and Factory Mutual Fire Insurance Companies.

Superior Tube owns both the new and old substations; both are 1500 kva. Total load is now 1400 to 1600 kw, and with new building each sub will be at about two-thirds capacity.

High-frequency signals provide . . .

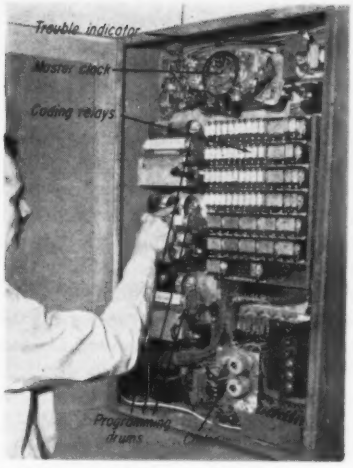
Programmed control of plant services

Central control of important production and plant-services operation is provided by a system of high-frequency signals transmitted over the normal power-distribution system at the new plant of Marchant Calculators, division of Smith-Corona Marchant Inc, Oakland, Calif. Marchant's present control plan operates 40 different circuits from a master *IBM* control panel. The system has six transmitters, with required number of receivers located at the equipment to be controlled.

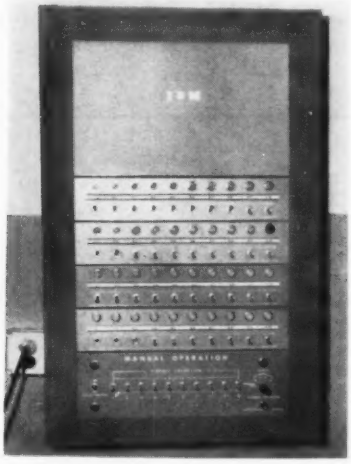
Automatic control can be programmed into the master controller, or control can be manual from the control center. No control wiring is used between transmitter and receiver; the high-frequency signals are applied to the entire electrical-distribution system. When it is time for a particular operation to be performed, the program drum initiates the signal through a coder, which signals the transmitters to send out pre-selected signals for the particular function. All receivers intercept this signal, but only those that are keyed to the signal respond to it. The signal may operate an "on" or "off" relay as intended.

In addition to the automatic operation of screw machines, the system controls (1) heating, cooling and ventilating equipment (2) interior and security plant lighting (3) time clocks, attendance and job recorders, and shift-change bells (4) clock correction. Receiver control panel, shown in top photo, has step controllers which start 80 screw machines in successive groups of six.

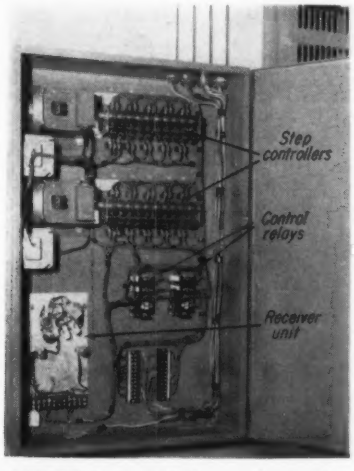
Electric-power distribution was designed with flexibility in mind. Three substations are located at strategic areas, each having two 3-phase 12-kv to 480/277-v transformers with individual feeders. Each transformer in first two substations is 1000 kva; they're 1500 kva in the third. Disconnect switches on primaries and tie breakers on secondaries make it possible to isolate defective transformer or feeder and swing load to other transformer. Busway is used for secondary distribution, with plug-in busway from panels to machines, using plug-in circuit breakers and flexible cable or conduit for final run. Trolley bus is used in some areas of plant.



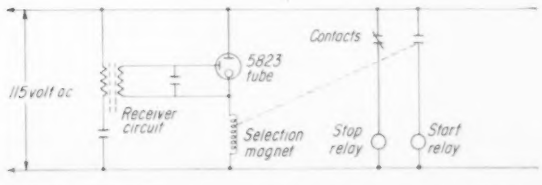
MASTER CONTROL panel has three programming drums, coder device, master clock



AUTOMATIC or manual control can be performed from central master control panel



RECEIVER is for typical control operations such as starting, stopping screw machines



TYPICAL RECEIVER circuit responds to its particular high-frequency low-power signal to open and close local control relays

INSULATED PANELS, double pane windows cut "U" of wall to 0.15

Largest air-source heat

A 600-ton system is now top size in air-source heat pumps. Installed in Columbus and Southern Ohio Electric Co's new office building in Columbus, Ohio, it's part of an up-to-date mechanical package serving the structure's cooling and heating requirements.

Thought toward minimizing heat gain or loss is shown in building's outer covering. Stainless steel forms the skin and is glued to a honeycomb of fibre kraft paper filled with a phenolic-foam insulation. Prefabricated in sandwich form, each unit is dropped into vertical runners to provide a tight wall seal. Through-the-wall "U" coefficient of heat transfer has been reduced to 0.15 using the sandwich—equivalent to 28 in. of brick. Windows are double-glazed tinted glass, reducing both conduction effect and glare.

Winter loads present an interesting problem. On cold but sunny days both cooling and heating may be needed at perimeters. Heat for shaded perimeters is drawn from interior zones, which are always cooled because of high

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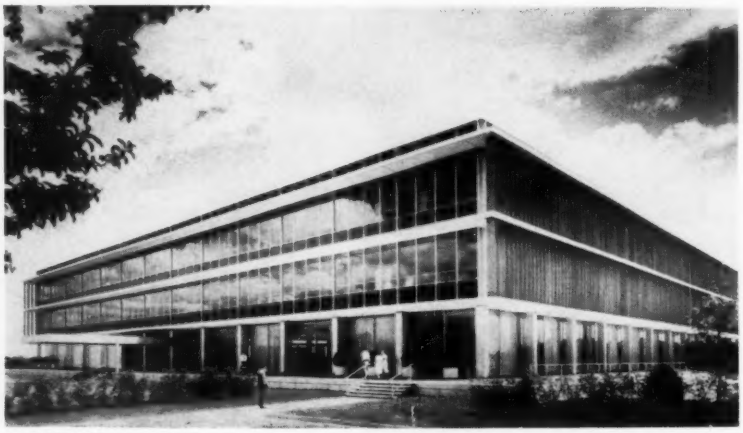
Engineers for Reynolds Metals building use . . .

A power-to-grow design for air conditioning



GLASS WALL, *right,* is shaded by automatic-turning louvers, cutting cooling 110 tons

Air conditioning that can grow —that's the mechanical-equipment theme of Reynolds Metals Co's new headquarters in Richmond, Va. The 4-story building typifies modern architectural treatment. And behind the scenes we find building services that are engineered right up to snuff.

Power to grow was the key to equipment selection for Ebasco Services Incorporated, project managers on the job. Cooling-tower piping, the incoming utility feeder cable, space allotment in the building distribution shafts and floor conduit and in the furnace and compressor rooms —all these were designed knowing that another, similar building and more equipment would be added later.

Present cooling load is sizable for a 4-story building—1200 tons. Two 600-hp centrifugal compressors do the work, dumping heat pickup to a condenser and tower. Two 10,350 lb-per-hr low-pressure boilers provide heating capacity.

Low-velocity insulated duct distrib-

pump installed in utility's new building

heat output of machines and workers, thus saving Btu's. Cool water is directed to the sunny walls, offsetting radiation effect. At night all perimeters are heated to keep the building temperatures from dipping too low.

Cooling and heating is all done electrically—by the heat pump. Range for the 600-ton pump is from 95 F in summer to –10 F in winter. Pump consists of two sets of three 100-hp compressors feeding a common system. There are also two small cooling systems (25-30 hp) serving the utility dispatch room and the accounting-machine areas. These rooms need ultrafine temperature and humidity control to protect their sensitive machines.

Air is distributed by a high-velocity system. First it's cleaned by electrostatic filters, passed through a heat exchanger-spray dehumidifier, and pumped down into the building. In summer, refrigerant cools building air, dumping heat outside; in winter, outside air supplies building heat. During mild weather, the condenser works by spray evaporation, but in winter heat transfer is air-to-refrigerant, since the spray would freeze.

Cold water and either hot or cold air are both circulated to conditioning units under each window. Thus the perimeter climate is under individual control, which is important due to sun effect both in summer and winter. The interior zones are handled in a conventional manner, using ceiling diffusers and reheat coils for final air control.

Centralized control is employed to keep track of building conditions. Temperatures and valve setting indications are received and messages can be sent to the controlling elements to bring the system back to a desired [illegible] if it drifts away.

An interesting application of Btu saving is utilized by the consultants, Ebasco Services Incorporated, in the mechanical setup. By state law, air passing into all rest rooms must be exhausted so it doesn't recirculate. To save the heat in this exhaust, spent air is piped to a small heat pump (25 hp) on the roof before it is exhausted to atmosphere. Here the heat is recaptured and used to warm building's domestic hot water to 130 F.

utes the air. It leads from a 10-unit fan room to large hollow shafts near the inside corners of this hollow-rectangular building. At each upper level, branches lead off between a honeycombed false ceiling and the main steel work. The ceiling adds beauty, and also effectively diffuses light and air. Air diffusers, reheat coils, return-duct openings, thermostats and lighting fixtures are also located in the open area above the honeycomb.

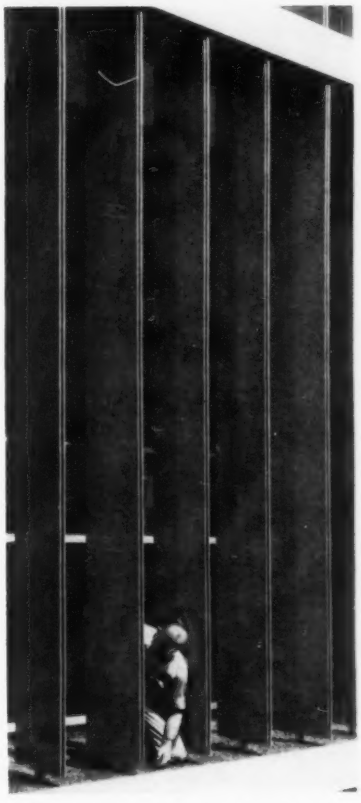
All equipment is controlled from one centralized room. Here tabs are kept on temperatures and pressures in 75 different areas, and signals are then sent out to controlling units spotted throughout the building. This type of control system saves the work of eight men: a single worker can observe and maintain all building conditions.

Movable louvers, placed on the exterior of all east and west walls, cut the cooling load by shading critical windows (an overhang shades the south wall, which is all glass). Made of aluminum, the louvers reflect most radiant heat, so that it can't enter the building before reflection takes place, as happens with venetian blinds. For a second advantage, louvers also minimize objectionable glare in the office spaces.

Small motors, actuated by a master clock, turn the louvers to keep them slightly ahead of the sun. A light-sensitive cell detects shading due to clouds and swings the blinds at right angles to the building for needed light. When the sun comes back out, the clock takes over again, moving the blinds ahead to the proper position for that time of day, not just back to their position before the sun was shaded. The clock is adjusted to anticipate hourly and seasonal changes in the sun's position until 2100 AD.

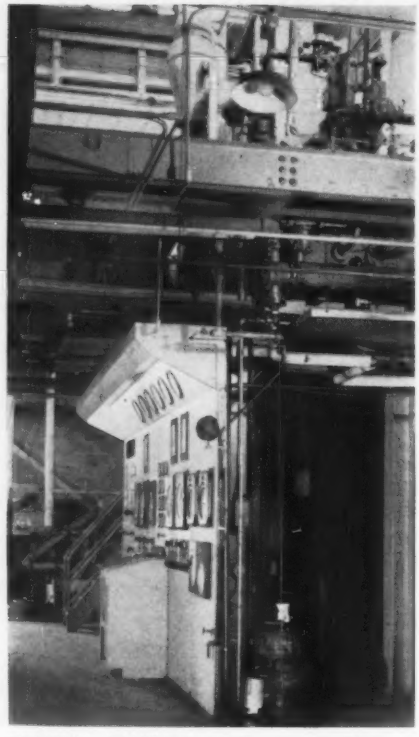
The louver-clock combination cuts an estimated 110 tons of cooling load from that handled by building equipment. This is about 10% of the present load, a sizable saving.

Reynolds building is a good example of engineering and architectural good sense. Knowing expansion would come, designers applied PTG wherever possible, even to the louver clock. And the building shows that materials which are effective mechanically can also be used to good advantage in architectural design.

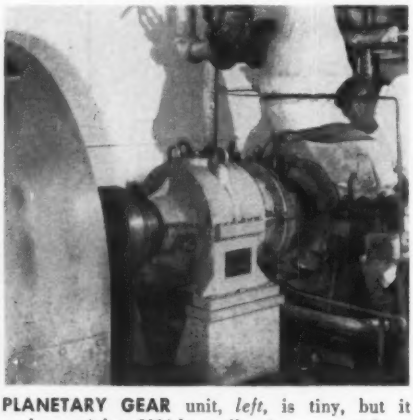


LOUVERS open outward when it's cloudy

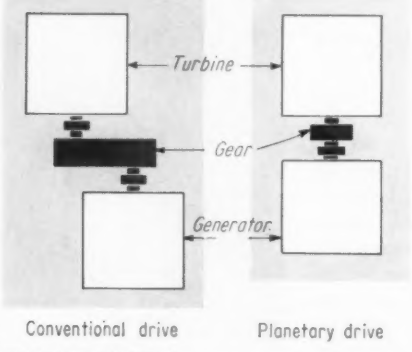
First large U.S. planetary reduction gear helps halve plant expansion costs



CONTROL PANELS for boiler and turbine are under new turbine-generator in the old building



PLANETARY GEAR unit, *left*, is tiny, but it packs a mighty 2800-hp wallop into one package



SPACE IS SAVED by using the planetary gear, *right*, mainly because reduction gear is in line

Something new has been added in mechanical power transmission—the De Laval-Stoeckicht planetary reduction gear. On its first installation two years ago at the Homasote Co, Trenton, N. J. manufacturers of pulpboard, insulation and high-density fiberboard, this gear coupled with extensive heat-balance studies cut plant expansion costs to about $125,000 from an estimated $350,000. The smaller unit fitted into the existing building; eliminated the need for an addition to the old plant, and saved the cost of piping, building materials, etc.

Process steam from two 135-psi scotch boilers couldn't meet production demands. A 450-psi 600-F boiler installed a few years before was used at 135-psi for process steam only. Power came from the Public Service Co.

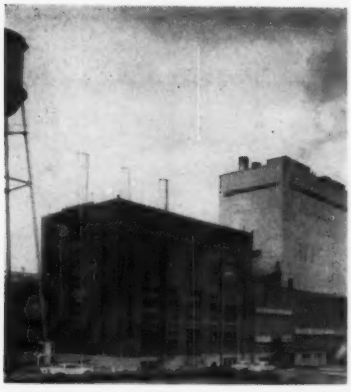
When a fourth mill section had to be added, first thought was to install another boiler—second thought to add an automatic-extraction turbine. Heat-balance studies indicated the existing boiler could do the job by working at full rated capacity through a back-pressure turbine that exhausted steam for process at 135 psi. The eliminated boiler equipment or extraction turbine and new housing would have brought costs above $350,000.

Placing a planetary gear reduction between turbine and generator allowed this new power unit to be installed on a mezzanine alongside the old high-pressure boiler. So they didn't have to add to their plant.

Now, 450-psi steam goes directly to a De Laval turbine rated at 440-psi, 550-F inlet and 135-psi back pressure. The planetary gear rated at 2800 hp reduces 4600-rpm turbine speed to a generator speed of 1200 rpm. The General Electric Co generator is of the open dripproof type, rated at 1250 kw, with 80% power factor, 4160 v, 60 cycle, three phase.

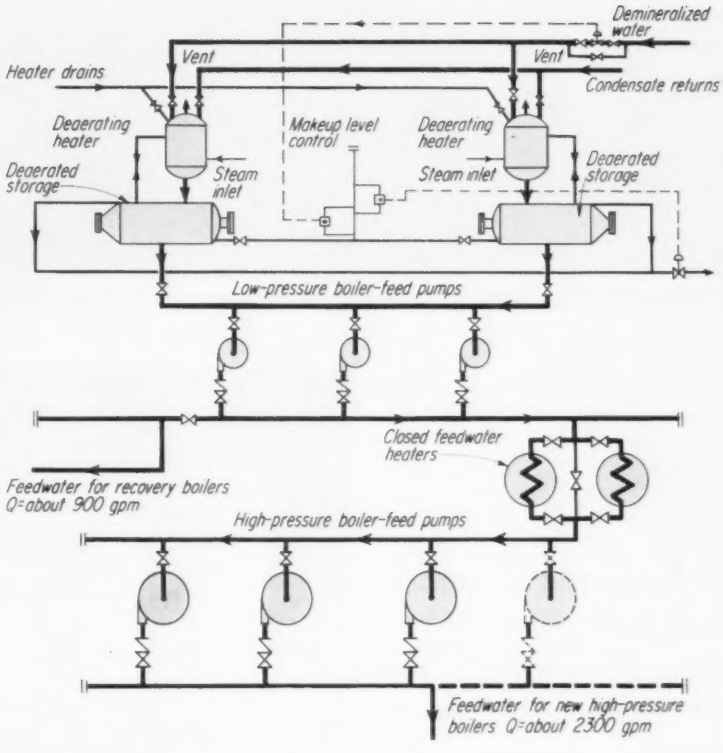
At peak loads they still need to buy some outside power, and they still have to use their scotch boiler. But at any reduction from present peak in the processing load, the high-pressure boiler and turbine-generator could supply all power and all process steam.

After two years of constant operation, the new planetary gear has given trouble-free service and has proved entirely practical for this modernized plant.



POWER PLANT at International Paper Co mill includes two new high-pressure power boilers and a 40,000-kw turbine-generator

FEEDWATER SYSTEM is combined in main power plant. Booster pumps feed recovery boilers, high-pressure boiler-feed pumps →



Better performance, less maintenance, smaller size are dividends when . . .

High-speed pumps feed high-pressure boilers

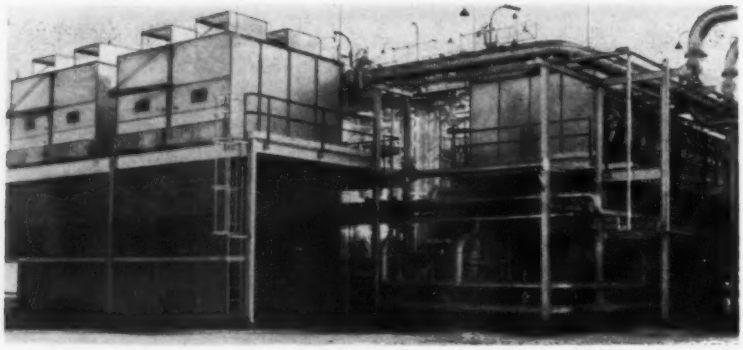
High-speed boiler feedwater pumps have many advantages over pumps operating at 3600 rpm. Size is reduced since fewer stages are needed and impeller diameter called for is much smaller. Maintenance is reduced because the shorter, more rigid shaft decreases wear at running joints. High-speed pumps have less than one-third the deflection of similar low-speed units. Pump life is greatly affected by shaft deflection and internal clearances. The greater the margin between these two, the longer the expected life. If a turbine drive is used, performance of the turbine is greatly improved at operating speeds of 6000 to 9000 rpm.

In a closed feedwater cycle, greater npsh needed for a high-speed pump is easily provided by the condensate pump. But in an open cycle it's impractical to elevate the deaerator enough to give sufficient head. So a booster pump is added between deaerator and boiler-feed pump.

Keeping these advantages in mind, International Paper Co, Mobile, Ala., decided to use high-speed pumps for their recent expansion involving two new power boilers and a 40,000-kw turbine-generator. Each boiler has a capacity of 450,000 lb per hr steam (1450 psig, 1000 F at superheater outlet). They also operate four recovery boilers (425 psig, 700 F at superheater outlet) located quite some distance from the main power plant.

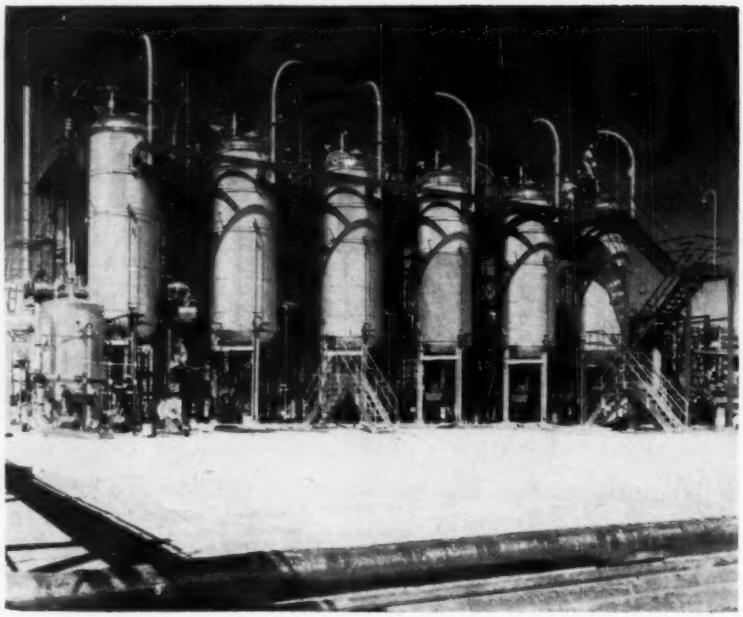
Each Worthington high-speed, barrel type feed pump has 565,000 lb per hr capacity at a discharge of 1810 psig. Steam turbines drive them at a speed of 6500 rpm. Booster pumps, flow diagram above, provide npsh needed for the high-speed units.

Enough capacity is included in the booster pumps to provide feedwater for the recovery boilers. Each pump is two stage, motor driven, and able to deliver 1600 gpm at a discharge of 625 psig. Combining these feedwater systems at the main power plant made it possible to reduce the number of operating personnel needed. And the two existing turbine-driven feed pumps at the recovery-boiler plant are now available as spares.



EVAPORATIVE CONDENSERS with 25,500-sq-ft cooling surface precool butadiene to liquid

Continuous flow replaces crude batch method of rubber production. Change from jacket to coil cooling backed by accurate, complete control does the trick



AMMONIA COILS inserted in shells absorb 110-ton cooling load per vat, maintain 42 F

Revamped cooling layout speeds process

For years effective cooling and process control posed problems to steady-flow latex production. Now neither gives trouble at General Tire and Rubber Co's 40,000-ton-per-year new-rubber plant, Odessa, Tex.

Cooling problem was licked first. In the 1940's a batch method was used to produce latex in jacketed vats (by chemically combining butadiene and styrene, natural-gas byproducts). Circulating brine did the reaction cooling, but not efficiently. If too cold, brine froze rubber mixture closest to jacket, insulating center of mixture from further cooling. If too hot, brine didn't cool anything right. Results were runaway reactions, dumped product.

Frick Co stopped these problems in 1955. They scrapped jackets, inserted ammonia coils in the vats. Cooling then became simple, but process was still by batches.

Final step was taken last year at the new Odessa plant. A central control system of 880 instruments now keeps tight rein on both chemical and cooling cycles. Mixture is precooled, then pumped continuously through a series of vats and on to final processing. Sets of evaporative condensers do the precooling, also remove 22,000 Btu per min picked up by NH_3 from each shell (which keeps them at 42 F). Improved chemical equipment and a tightly grouped plant layout are also major changes.

Final results: smooth production with process time cut, equipment cleaning downtime trimmed, and product loss eliminated.

Power OCTOBER 1958

Industrial Plant Design Survey

Following pages summarize design features found in newly completed industrial plants, in some plants still under construction, and in others yet on the drawing board. The survey includes three power areas: *electrical distribution, industrial power plant, packaged boilers.*

We believe the survey of electrical-distribution practice, which starts on the following page, is the first of its kind to appear in print. Here we probed for the design parameters that power men are most interested in now. It covers the industrial electrical scene in the plants surveyed from the incoming primary substation through the primary and secondary circuitry and on to the lighting and motor loads.

Shifting over to the mechanical-engineering side, note the industrial power-plant segment contains about double the information on any single plant compared to past POWER surveys. The packaged-boiler tabulation as such is brand new.

But because of the way we must compile facts the survey has its limitations. We started the job by first listing installations planned or on order. We then sent questionnaires to individual companies asking for project details. The replies went into the tables. So, by the very nature of things, you can see these tabulations can't be complete. But since they're representative of current design and construction, you do get useful information on general trends.

So once again: these are not complete lists, but extensive samples. Don't use survey facts to get total figures on capacities, sales, or where incompleteness of basic design data may distort results.

1958 electrical systems design survey:

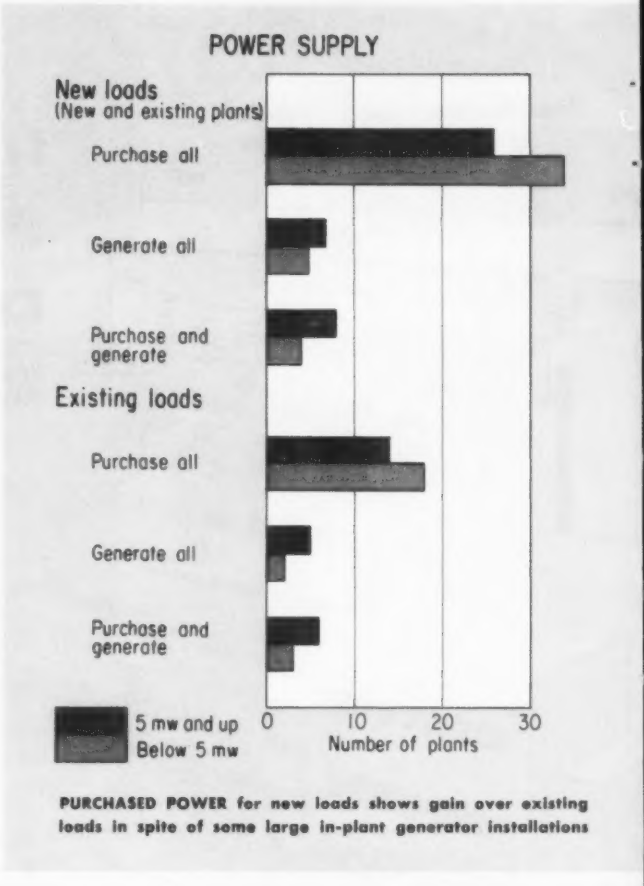
DISTRIBUTION TRENDS

- **More self-ownership of primary subs**
- **Neutral grounding leads nearly 2 to 1**
- **480/277-v is favorite for secondaries**
- **Capacitors used in 30% of plants**

Design features of the electrical-distribution systems in the 69 plants surveyed are summarized at right and on p 108. Tabulation of pertinent data starts below and carries over to p 108. On p 109 the tabulation is picked up again and carried over through pp 110 and 111. Although but a relatively small sampling is represented here, it may be considered typical of current practice.

Data in the summaries are divided into two groups, based on a plant's electrical size: five mw is the dividing line. Hence the double-bar charts. Example: Primary selective schemes are used about as often as radial in plants five mw and larger. But in the smaller-capacity group they are used in about one-third as many plants as the more simple radial circuitry.

When interpreting trends from these summaries, check into the tables for influencing factors. Number of plants generating electricity as shown by the bar charts, for example, doesn't by itself indicate the magnitude of the generator-fed load. Likewise, nature of the manufacturing process would be a consideration.



PURCHASED POWER for new loads shows gain over existing loads in spite of some large in-plant generator installations

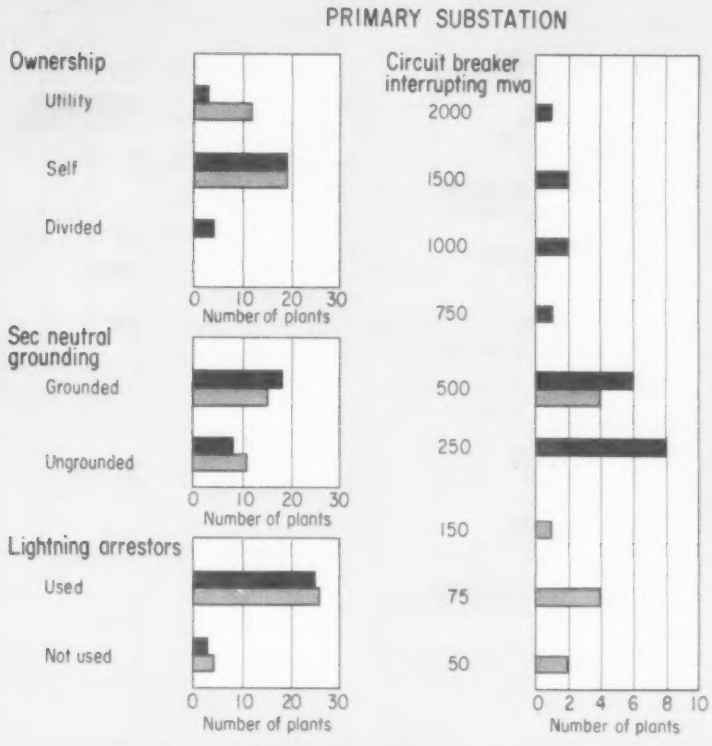
Design features of 69 typical electrical

Each listing covers 3 pages. Project number helps you track a specific installation after you turn facing page

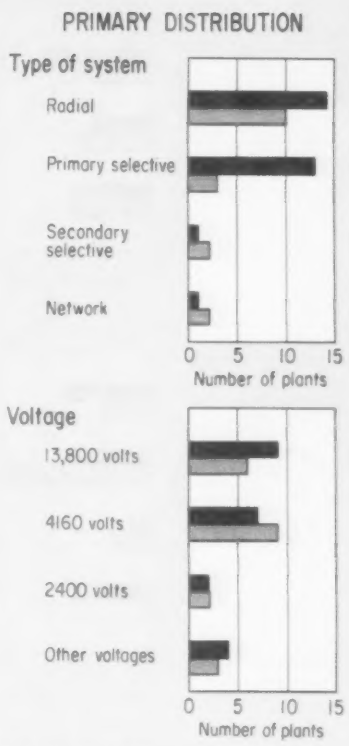
Project No.	Company	Location	Electric Utility	Consulting Engineers	Date of initial operation	Plant area, acres	Total plant capacity, mw	NEW PLANT — TOTAL LOAD (megawatts) — SELF GENERATED* Max Mw	SELF GENERATED* Avg Pf	UTILITY FED* Max Mw	UTILITY FED* Avg Pf	Demand interval for billing, minutes	EXISTING PLANT — EXISTING LOAD — SELF GENERATED Max Mw	SELF GENERATED Avg Pf	UTILITY FED Max Mw	UTILITY FED Avg Pf
1	Kennecott Copper Corp	Magna, Utah		Kuljian Corp	—	—	175	—	—	—	—	—	100	—	—	—
2	Southland Paper Mills, Inc	Lufkin, Texas			—	—	84.0	—	—	—	—	15	57	.92	—	—
3	Corbett Lumber Co	Wilmington, N.C.	Carolina P & L Co		11-58	15	73.4	—	—	73.9	.80	15	—	—	3.3	.70
4	Spruce Falls Power & Paper Co	Kapuskasing, Ontario	Public Utilities Comm		—	500	72.1	9.1	.85	—	—	10	53	.98	5.5	.98
5	St. Joseph Lead Co	Bonne Terre, Missouri	Union Electric Co		—	—	56.0	—	—	26	.90	15	—	—	40	.96
6	Dow Chemical Co	Plaquemine, La	Gulf States Utilities Co	Bechtel Corp	10-58	—	55.0	50	.85	5.0	.90	30	—	—	—	—
7	The Texas Co	Port Arthur, Texas	None		—	—	47.6	15.6	.90		—	—	26	.90	—	—
8	Hammermill Paper Co	Erie, Pa	Penna. Elect. Co	Rust Engr Co	—	225	33.0	—	—	4.0	.87	15	15	.90	5.0	.90
9	Diamond Gardner Corp	Red Bluff, Cal	Pacific G & E Co		—	400	32.0	—	—	—	—	30	—	—	5.0	.80
10	Convair, Div of General Dynamics	San Diego, Cal	San Diego G & E Co		4-57	200	22.0	—	—	—	—	15	—	—	13.0	.87

* - Maximum mw, average pf
Div - Divided ownership
Var - Various
AC - Allis Chalmers Mfg Co
CGE - Canadian General Electric Co Ltd

typical industrial plants, institutions



SELF OWNERSHIP, secondary neutral grounding advance over previous industrial surveys. Lightning arrestors are nearly universal where plants have some overhead power lines



RADIAL SYSTEMS prevail in smaller, are used half-time in larger plants

continued on next page ▶

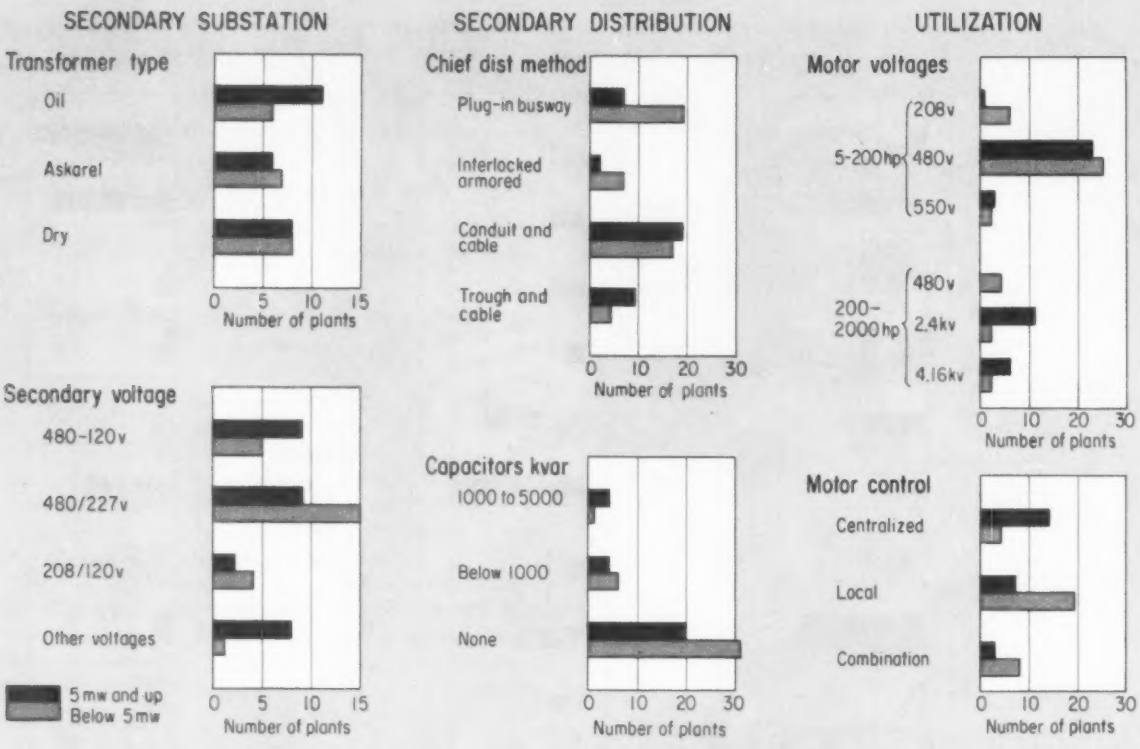
distribution systems, new and modernized

EXISTING PLANT (Cont.)				LOAD DIVISION (percent of total load)					PRIMARY SUBSTATION														
NEW LOAD													TRANSFORMERS					SWITCHGEAR					
SELF GENERATED		UTILITY FED																					
Max Mw	Avg Pf	Max Mw	Avg Pf	Lighting, %	Motors, %	Welding, % (Supply Capacity)	Heat and process, %	Dc, %	Ownership	Utility supply voltage, kv	Available s-c Current, 1000 amps	Lightning arresters	Number	Manufacturer	Total capability, mva	Impedance, %	Secondary neutral grounded	Automatic voltage regulator	Manufacturer	Load-break switches	Circuit breaker, 3-ph interrupting mva	Ultimate sub capacity, mva	Project No.
75	85	—	—	—	—	—	—	—	Self	44	—	Yes	1	GE	90	—	No	No	WE	No	2000	234	1
8.1	90	18.9	90	2	86	1	0	11	Self	138	—	Yes	2	WE	90	8.25	No	Yes	GE	Yes	500	50	2
—	—	23.6	80	5	85	10	—	—	Utility	—	—	—	—	—	—	—	—	—	—	—	—	—	3
5.0	—	—	—	2.5	97.5	—	—	—	Self	110	—	Yes	6	WE	64.5	9.5	No	No	CGE	No	—	69	4
—	—	26	90	5	80	2	1	12	Div	34	—	Yes	8	Var	26	Var	Yes	No	Var	Yes	—	30	5
—	—	—	—	—	—	—	—	—	Div	138	—	Yes	1	WE	50	8.17	Yes	Yes	WE	No	1500	50	6
6.0	90	—	—	10	89	0.8	0.2	—	—	—	10	Yes	—	Var	51	4.5–7.2	No	No	Var	Yes	1000	—	7
—	—	9.0	80	10	80	2	8	—	Self	33	20	Yes	2	GE	22	6.0	Yes	No	GE	Yes	1500	40	8
—	—	27	85	10	75	0	10	5	Utility	60	—	Yes	—	—	15	—	Yes	No	GE	Yes	250	38	9
—	—	9.0	1.0	36	44	2	18	—	Self	12	4.8	Yes	10	Z	10	5.5	Yes	No	WE	Yes	250	30	10

GE - General Electric Co
ITE - I-T-E Circuit Breaker Co
SCE - S&C Electric Co
SP - Supreme Power Co, Ltd
WE - Westinghouse Electric Co
Z - GE, WE, ITE, Federal Pacific

continued on next page ▶

Electrical distribution trends continued



OIL-FILLED is used in large plants, dry in smaller, askarel used least

CONDUIT AND CABLE keeps its lead but plug-in busway is big challenger

MOTORS up to 200 hp operate mostly at 480 v; larger at 2.4 and 4.16 kv

Electrical design features continued

Project number	GENERATORS					PRIMARY DISTRIBUTION (ABOVE 600 v)					SECONDARY SUBSTATIONS					SECONDARY DISTRIBUTION		PLANT LIGHTING			UTILIZATION				MOTOR CONTROL			
	NEW UNITS											TRANSFORMER									MOTOR VOLTAGE							
	Voltage, v	Kva	Pf	Manufacturer	Total generating capacity, kva	Circuitry	Voltage, kv	Overhead or underground	Distribution means	Cable mfr	Unit sub mfr	Transformer type	Manufacturer	Secondary voltage, v	Auto volt reg	Means	Manufacturer	Type	Fixture mfr	277 v	5-200 hp	201-2000 hp	2001 D-upward	Total motor hp	Motor mfr	Centralized or local	Control mfr	Capacitors, kvar	Manufacturer
1	13.8	68,200	85	GE	200,000	Ps	44	Over	Ac	—	GE	A	GE	480	No	Cc	—	I,Mv	—	No	440 2300	—		—	GE	Cen	FP	—	—
2	—	—	—	—	73,000	Rd	6.9	—	Cc,Ia	GE	ITE	A	ITE	2400	No	Cc	GE	I,Mv	BE,CR	No	480	2400	6900	—	AC,EM,GE	Cen	AB,GE	—	—
3	—	—	—	—	—	SS	13.2	Over	Ac,Cc	AWC	—	—	—	—	—	Cc,Tc	AWC	F,I	WE,H	—	480	—	—	1,100	AC,GE,WE	Cen	GE,WE	—	—
4	—	—	—	—	—	Rd	6.6	Over	Ac,Cc	CGE, CW&C	CGE,WE	Oil	CGE,WE	2200 &550	No	Cc,Tc	CW&C	F,I,Mv	CGE, AM	No	550	2200	6600	80,000	CGE	Cen	CGE,CH	—	—
5	—	—	—	—	—	Network	4.16	Over	Ac	Var	—	Oil	Var	440	No	Cc,Tc	—	F,Mv	Var	No	440 2300 2300 4160		—	20,000	Var	Cen	Var	—	—
6	14.4	—	—	GE	58,824	Rd,Ps	14.2	Over	Ac	RC,SW	WE	Oil	WE	2400	No	Cc,Tc	Var	F,I,Mv	Var	No	480	2400	—	—	AC,GE,WE	Cen	GE	—	—
7	2.4 13.8	—	90	GE,WE	73,750	Rd	33	Over	Ac,Cc	Var	Var	Oil	Var	2400	No	Cc	—	F,I,Mv	Var	No	—[1]	2400	0	90,000	Var	Loc,Cen	Var	4000	Var
8	—	—	—	—	30,000	Rd,Ps	13.8	Under	Cc	GE,WE	GE,WE,AC	O,D,A	—	2400	No	Ia,Cc,Tc	—	F,I,Mv	DB	Yes	480	2400	—	70,000	Var	Cen	GE	—	—
9	—	—	—	—	—	Ps	12	Over	Ac,Ia	OK	GE	A	GE	[2]	No	Ia,Cc	OK	F,Mv	WE,H	—	480	—[2]	—	—	GE,LA,WE	Cen	GE,SD	—	—
10	—	—	—	—	—	Rd	12	Both	Cc,Ia	Var	—	—	—	—	—	Pib	SD,T	F	FF	Yes	440	—	12,000	10,000	AC,ED	Loc	Var	—	—

* - Maximum kw, average pf
1 - 1/4-100 hp, 240 & 480 v; 100-200 hp, 2400 v
2 - 480v & 2300v
3 - Also 230 volt dc
6 - Emergency
13 - Rockland Electric Co & Public Service E & G Co

Ia - Beeman, Britt, Curley & Jaffer
15 - J. C. Turnbull & Wigton-Abbott Corp
A - Askarel
Ac - Aerial cable
Cc - Cable & conduit
D - Dry
Db - Direct burial

Div - Dividend ownership
F - Fluorescent
I - Incandescent
Ia - Interlocked armor
Mv - Mercury-vapor
O - Oil
Pib - Plug-in busway

Ps - Primary selective
Rd - Radial
Ss - Secondary selective
Tc - Trough & cable
Var - Various
AB - Allen-Bradley Co
AC - Allis-Chalmers Mfg Co
ACC - Aluminum Company of Canada

Electrical distribution systems design survey

Compiled by:
J. W. Follansbee & Norman Peach, Assistant Editors

Project number	Company	Location	Electric Utility	Consulting Engineer	Date of initial operation	Plant area, acres	Total plant capacity, mw	NEW PLANT TOTAL LOAD (megawatts) SELF GENERATED Max Mw	SELF GENERATED Avg PF	UTILITY FED Max Mw	UTILITY FED Avg PF	Demand interval for billing, minutes	EXISTING PLANT EXISTING LOAD SELF GENERATED Max Mw	SELF GENERATED Avg PF	UTILITY FED Max Mw	UTILITY FED Avg PF	Project number
11	St. Regis Paper Co	Deferiet, N.Y.	Niagara Mohawk Power Co		6-58	—	22.0	—	—	—	—	15	9.9	.94	9.9	.94	11
12	Port of New York Authority	Idlewild Airport, N.Y.	Con Ed Co		—	5070	21.0	—	—	5	.90	30	—	—	10.0	.90	12
13	Lockheed Aircraft Corp	Sunnyvale, Cal. (Missile Div).	Pacific G & E Co	various	10-59	275	17.3	—	—	12	.80	15	—	—	2.6	.95	13
14	Great Northern Paper Co	Millinocket, Me.		Stone & Webster Engr. Co	—	—	15.6	15.6	.80	—	—	—	—	—	—	—	14
15	John Deere Waterloo Tractor Works	Waterloo, Iowa	Iowa Public Service Co		—	210	13.3	—	—	—	—	15	12.8	—	—	—	15
16	General Electric Co	Pinellas County, Fla.	Florida Power Corp		5-57	95	13.2	0.20[6]	.80	5.0	.80	30	—	—	8.0	.80	16
17	National Forge and Ordnance Co	Irvine, Pa.	Penna. Elect Co	none	8-58	25	11.0	—	—	—	—	15	—	—	8.0	.75	17
18	Cities Service Refinery	Bronte, Ontario	Public Utilities Comm	C. F. Braun	12-58	600	9.0	.025[4]	1.0	8.5	.85	15	—	—	—	—	18
19	The California Oil Co	Perth Amboy, N.J.	Public Service E & G Co	H. K. Ferguson	12-58	460	8.3	—	—	—	—	15	4.5	—	0.5	—	19
20	Abitibi Corp	Alpena, Mich.	Alpena Power Co	Stone & Webster Engr. Corp	—	—	8.25	6.25	.80	2.0	1.0	—	—	—	—	—	20
21	Chrysler Corp, Ohio Stamping Plant	Twinsburg, Ohio	Ohio Edison Co	Albert Kahn	3-58	34	7.65	—	—	7.65	.85	30	—	—	—	—	21
22	John Deere Harvester Works	East Moline, Ill.	Iowa-Illinois G & E Co		—	—	7.23	—	—	—	—	30	7.2	.85	—	—	22
23	Evinrude Motors	Milwaukee, Wis.	Wisconsin Elec Power Co	Eschweiler & Eschweiler	2-57	—	7.2	—	—	1.2	.85	15	0	—	6.0	.85	23
24	American Airlines	Tulsa, Oklahoma	Pub. Serv. Co of Okla.	Coston & Frankfort	—	20	6.7	—	—	—	—	30	—	—	3.5	.90	24
25	John Deere Dubuque Tractor Works	Dubuque, Iowa	Interstate Power Co		—	86	6.25	—	—	—	—	30	5.15	.85	0.45	.85	25
26	E. St. Louis & Interurban Water Co	E. St. Louis, Ill.	Union Electric Co		3-58	—	6.25	.85	.80	2.7	.80	15	.85	.80	1.1	.80	26
27	Callery Chemical Corp	Muskogee, Okla.	Oklahoma G & E Co		—	—	6.0	0.5	.80	6.0	.90	30	—	—	—	—	27
28	Marquardt Aircraft Co	Ogden, Utah	Utah Power & Light Co		12-58	67	6.0	—	—	—	—	15	—	—	4.0	.85	28
29	U. S. Gypsum Co	Galena Park, Texas	Houston L & P Co		2-59	20	6.0	—	—	—	—	15	—	—	3.0	.94	29
30	Standard Steel Works Div	Burnham, Pa.	Penna. Electric Co		8-58	—	5.25	—	—	—	—	15	—	—	—	—	30
31	Mission Mfg	Houston, Texas	Houston L & P Co		6-58	3	5.2	—	—	4.0	.95	15	—	—	1.2	.96	31
32	Kaiser Aluminum & Chem. Corp	Erie, Pa.	Penna. Electric Co		9-58	25	5.0	—	—	—	—	15	—	—	2.0	.80	32
33	Addressograph Multigraph Corp	Cleveland, Ohio	Cleveland Elec. Illum Co	Ferguson Co	—	23	4.4	—	—	—	—	30	—	—	3.2	.99	33
34	John Deere Des Moines Works	Des Moines, Iowa	Iowa P & L Co		—	525	4.15	—	—	—	—	—	2.7	.85	1.3	.85	34
35	Hackensack Water Co	Oradell, N.J.		(See footnote 13)	—	—	4.0	—	—	—	—	15	—	—	2.0	1.0	35
36	Carlisle Finishing Co	Carlisle, S. C.	South Car. E & G Co	J. E. Sirrine	12-57	13	3.8	—	—	3.8	.85	15	—	—	—	—	36
37	Sperry Microwave Electronics Co	Clearwater, Fla.	Florida Power Corp	(See footnote 14)	1-58	—	3.5	—	—	—	—	30	—	—	1.5	—	37
38	Boeing Airplane Co	Moses Lake, Wash.	Grant Cty. Pub. Util. Dist.	Bullion & Griffiths	—	—	3.2	—	—	—	—	15	—	—	1.5	.95	38
39	Allen Mfg Co	Hartford, Conn.	Hartford Elec. Light Co		—	4	3.0	—	—	3.0	.90	30	—	—	—	—	39
40	Corps of Engineers	New Egypt, N.J.		(See footnote 15)	—	100	3.0	3.0	.8	—	—	—	—	—	—	—	40
41	General Aniline & Film Corp	Linden, N.J.	Public Serv. E & G Co		1-58	—	3.0	—	—	3.0	.88	30	—	—	—	—	41
42	Marchant Calculators Div	Oakland, Cal.	Pacific G & E Co	L. Paton	8-58	4	3.0	—	—	3.0	—	30	—	—	—	—	42
43	Ramsey Corp	Manchester, Mo.	Union Electric Co		7-58	2.5	3.0	—	—	—	—	—	—	—	2.0	.85	43
44	IBM	Rochester, Minn.	City of Rochester	Smith, Hinchman, Gryll	—	—	2.5	—	—	2.5	.88	—	—	—	—	—	44
45	Nassau Smelt & Refining Co	Staten Island, N.Y.	Con. Ed. Co. of N.Y. Inc.		—	40	2.5	—	—	—	—	15	—	—	2.0	.99	45
46	Southern Pine Lumber Co	Pineland, Texas			5-58	100	2.5	2.5	.70	—	—	—	—	—	—	—	46
47	John Deere Wagon Works	Moline, Illinois	Iowa-Illinois G & E Co		—	—	2.4	—	—	—	—	30	—	—	.70	.85	47
48	Danly Machine Specialties, Inc	Chicago, Ill.	Cen. Ill. Pub. Ser. Co		12-57	19	2.1	—	—	5	.93	30	—	—	1.6	.93	48
49	Florida State Hospital	Chattahoochee, Fla.		Reynolds, Smith & Hill	—	—	2.0	2.0	.85	—	—	—	—	—	—	—	49
50	Southwestern Indust. Electronics	Houston, Tex.	Houston L & P Co	Bernard Johnson & Assoc	—	4.2	1.75	—	—	1.75	.98	15	—	—	—	—	50
51	American Gilsonite Co	Gilsonite, Col.	Pub. Ser. Co. of Col.		1957	32	1.60	1[4]	.80	1.6	.81	15	—	—	—	—	51
52	The R. T. French Co	Shelley, Idaho	Utah P & L Co	Henry Peck Assoc	—	20	1.38	—	—	—	—	—	—	—	78	.80	52
53	Farmers Union Central Exchange	Laurel, Mont.			—	100	1.30	—	—	1.3	1.0	—	—	—	—	—	53
54	Babcock & Wilcox Co	Barberton, Ohio	Ohio Edison Co		—	—	1.25	—	—	—	—	—	—	—	25	.90	54
55	The Quaker Oats Co	Shiremanstown, Pa.	Penna. P & L Co		—	23	1.25	—	—	.75	.85	15	—	—	.50	.85	55
56	Minneapolis-Honeywell Regulator Co	St. Petersburg, Fla.	Florida Power Corp		6-58	97	1.00	—	—	1.0	.90	—	—	—	—	—	56
57	Chippewa Plastics Co	Chippewa Falls, Wis.	Northern States Power Co		8-58	0.5	0.98	—	—	.75	.90	15	—	—	.23	.84	57
58	Minnesota Rubber Co	Minneapolis, Minn.	Northern States Power Co		9-57	1.5	0.95	—	—	.40	.80	15	—	—	.55	.87	58
59	Acme Industries, Inc	Jackson, Mich.	Consumers Power Co		1-57	54	0.948	—	—	.488	.88	15	—	—	.46	.95	59
60	East Moline State Hospital	East Moline, Ill.		Consoer & Townsend	—	—	0.80	0.8	—	—	—	—	.60	—	—	—	60
61	Institutional Industries Inc	Cincinnati, Ohio	Cincinnati G & E Co		3-58	—	0.80	—	—	.80	—	15	—	—	—	—	61
62	Vulcan Mfg. Co	Cincinnati, Ohio	Cincinnati G & E Co		3-59	5	0.80	—	—	.50	.85	15	—	—	.30	.60	62
63	Nutrone, Inc	Cincinnati, Ohio	Cincinnati G & E Co		—	20	0.76	—	—	—	—	—	—	—	.65	.75	63
64	The Kendall Co of Canada, Ltd	Toronto, Ontario	East York Hydro System	Laughlin, Wylie, & Ulnal	—	2	0.75	—	—	.75	—	—	—	—	—	—	64
65	Storm Windows of Aluminum Co	Kent, Ohio	Ohio Edison Co	Loomis Elect	11-57	1	0.70	—	—	.35	.85	30	—	—	.23	.80	65
66	Orange County General Hospital	Orange, Cal.	So. Cal. Edison Co	A. M. Hapler, S. Steele	—	22	0.465	—	—	—	—	—	115[5]	—	115	—	66
67	Foulke Fur Co	St. Louis, Mo.	Union Electric Co	J. Falvey	1-58	—	0.40	—	—	—	—	15	—	—	.30	.80	67
68	Teletype Corp	Little Rock, Ark.	Arkansas P & L Co		11-57	2	0.375	—	—	.375	.85	15	—	—	—	—	68
69	Koppers Co., Inc	Newell, W. Va.	Monongahela Power Co		6-57	4	0.30	—	—	.30	.93	15	—	—	—	—	69

AM - Amalgamated
AWC - Anaconda Wire & Cable Co
BE - Benjamin Electric Mfg Co
CGE - Canada General Electric Co Ltd
CH - Cutler-Hammer, Inc
CR - Crouse-Hinds Co
CWC - Canadian Wire & Cable Co, Ltd
DB - Day-Brite Lighting, Inc
E - Electrolier Mfg Co Ltd
ED - Electro-Dynamic Div, General Dynamics Corp
EM - Electric Machinery Mfg Co
ET - Electric Tamper & Equipment Co of Canada Ltd
FF - Fluorescent Fixtures of California
FP - Federal Pacific Electric Co
GE - General Electric Co
H - Holophane Co, Inc
ITE - I-T-E Circuit Breaker Co
LA - The Louis Allis Co
NE - National Electric Products Corp
OK - The Okonite Co
PD - Phelps Dodge Copper Products
RC - Rome Cable Corp
SD - Square D Co
SP - Supreme Power Co, Ltd
SW - Simplex Wire & Cable Co
WE - Westinghouse Electric Corp
Zn - WE, GE, AC, Wagner
Zm - WE, GE, SD, AB

continued

Electrical distribution systems design survey

Project number	EXISTING PLANT (Cont.) NEW LOAD SELF GENERATED Max Mw	SELF GENERATED Avg PF	UTILITY FED Max Mw	UTILITY FED Avg PF	LOAD DIVISION (percent total load) Lighting, %	Motors, %	Welding, % (Supply Capacity)	Heat and process, %	DC, %	PRIMARY SUBSTATION Ownership	Utility supply voltage, kv	Available s-c current, 1000 amps	Lightning arresters	TRANSFORMERS Number	TRANSFORMERS Manufacturer	TRANSFORMERS Total capability, mva	TRANSFORMERS Impedance, %	TRANSFORMERS Secondary neutral grounded	TRANSFORMERS Automatic voltage regulator	SWITCHGEAR Manufacturer	SWITCHGEAR Load-break switches	SWITCHGEAR Circuit breaker 3-ph interrupting mva	SWITCHGEAR Ultimate sub capacity, mva
11	0.55	.94	0.55	.94	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	—	—	6.0	.90	75	15	0	10	—	Div	27.6	5.0	No	4	WE, ITE	20	—	Yes	Yes	WE, ITE	Yes	250	40
13	—	—	2.5	.85	30	45	5	20	—	Utility	110	1.5	No	3	GE	18	6.0	Yes	No	GE	Yes	500	30
14	—	—	—	—	—	—	—	—	—	Self	34.5	10	Yes	2	GE	53.3	7.0	Yes	No	GE	No	750	—
15	.375	.85	.125	.85	35	55	0	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	—	—	20	25	10	25	—	Utility	66	—	Yes	3	GE	75	—	Yes	Yes	GE	Yes	250	40
17	—	—	3.0	.80	2	25	1	72	—	Self	34.5	—	Yes	3	WE	3.15	6	No	No	WE	Yes	500	6.9
18	—	—	—	—	3	95	1	1	—	Self	27.6	3.5	Yes	2	CWE	20	5	Yes	No	CWE	Yes	500	20
19	—	—	3.3	—	10	90	—	—	—	Self	26	22	Yes	3	PTD	10.5	—	Yes	No	GE	No	1000	13.8
20	—	—	—	—	10	90	—	—	—	Self	33	1.0	Yes	1	WE	6.2	6	Yes	No	WE	Yes	250	—
21	—	—	—	—	50	40	10	—	—	Self	132	2.6	Yes	3	GE	30	8.2	Yes	Yes	AC	No	500	37.5
22	0.02	.85	—	—	25	60	10	5	—	—	48	9.0	Yes	—	—	—	—	—	—	—	—	—	—
23	—	—	—	—	7	63	0	30	—	Self	26.4	—	Yes	2	AC	3.0	6.6	No	No	AC	Yes	1.5	—
24	—	—	3.2	.90	75	—16	—16	—16	—	Self	69	—	Yes	2	GE	10	—	Yes	No	GE	Yes	—	—
25	0.70	.85	0.05	.85	35	55	0	10	—	—	4.16	—	Yes	—	—	—	—	—	—	—	—	—	—
26	—	—	.75	—	—	—	—	—	—	Self	4.16	—	Yes	4	WE	2.7	—	Yes	No	WE, GE	Yes	75	—
27	—	—	—	—	—	—	—	—	—	Self	67	6.2	No	2	GE	10	7	No	No	GE	Yes	250	10
28	—	—	2.0	.85	25	35	10	30	—	Self	44	8.5	Yes	1	WE	5.0	6.3	Yes	No	WE	Yes	250	5.0
29	—	—	3.0	.80	10	89	1	—	—	Self	69	13.4	Yes	1	GE	3.75	—	Yes	No	GE	Yes	—	7.5
30	—	—	5.25	.90	—	—	—	—	—	Self	46	—	Yes	2	GE	15	6.5	No	No	GE	Yes	500	18.8
31	—	—	—	—	20	40	0	20	20	Self	12	—	Yes	3	—	5.0	—	—	No	WTE	Yes	—	—
32	—	—	3.0	.95	1	90	0	4	5	Self	12	12	Yes	3	WE	4.5	5.5	Yes	No	WE	Yes	250	6.0
33	—	—	1.2	.99	35	40	5	18	2	Utility	33	—	Yes	6	GE	6.0	—	Yes	No	AC	Yes	150	8.0
34	0.1	.85	0.05	.85	80	20	—	—	—	—	13.8	—	Yes	—	—	—	—	—	—	—	—	—	—
35	—	—	2.0	1.0	10	90	—	—	—	Self	26	—	Yes	2	AC	10	6	No	No	AC	—	—	12
36	—	—	—	—	10	90	—	—	—	Utility	—	—	Yes	1	—	5.0	—	—	—	GE	Yes	—	—
37	—	—	2.0	—	25	50	0	15	—	Utility	66	—	Yes	—	—	—	—	Yes	No	CON	Yes	—	—
38	—	—	1.7	.95	40	55	0	0	5	—	13.2	—	Yes	—	—	—	—	Yes	—	GE	Yes	—	—
39	—	—	—	—	30	55	0	15	0	Utility	22	—	Yes	1	GE	3.3	—	No	No	GE	Yes	—	6.6
40	—	—	—	—	40	50	10	—	—	Self	—	—	Yes	8	UP, MT, GE	4.0	5	No	No	EU	No	75	5.0
41	—	—	—	—	5	95	—	—	—	Self	26	2.2	Yes	3	GE	5.0	5	Yes	No	GE	—	25	10
42	—	—	—	—	60	30	0	10	—	Self	12	—	No	—	—	7.0	—	Yes	No	GE	Yes	—	14
43	—	—	1.0	.85	35	50	—	15	—	Self	12.5	—	Yes	4	FP	3.7	6	—	—	FP	—	—	—
44	—	—	—	—	28	60	5	7	—	Utility	34.5	—	Yes	2	AC	20	5.5	No	No	—	—	—	—
45	—	—	5	.85	10	49	1	35	5	Self	0.96-4.16	—	Yes	0	Var	4.21	5	Yes	—	GE, WE, FP	Yes	50	42.1
46	—	—	—	—	5	44	—	50	1	Self	—	—	Yes	12	GE, ESC	5.0	—	Yes	No	GE	Yes	—	—
47	—	—	1.7	.85	15	35	45	5	—	—	13.8	10	Yes	—	—	—	—	—	—	—	—	—	—
48	—	—	—	—	27	57	16	—	—	Self	12	270	No	—	—	4.0	5.5	No	No	AC	Yes	500	—
49	—	—	—	—	50	50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50	—	—	—	—	20	75	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
51	—	—	—	—	15	76	5	4	—	Self	69	2.17	Yes	1	AC	3.0	7	Yes	No	AC	Yes	150	3.5
52	—	—	.60	.80	5	90	5	—	—	Self	15	—	Yes	1	GE	1.0	—	Yes	No	GE	Yes	—	1.0
53	—	—	—	—	20	78	2	—	—	Self	4.16	—	—	6	MO	3.0	—	—	—	WE	—	—	—
54	—	—	1.0	.90	80	20	—	—	—	Self	24	12.5	Yes	1	GE	1.5	6	No	No	EEE	Yes	—	7.5
55	—	—	—	—	15	85	—	—	—	Self	12	60	Yes	2	GE	1.75	5.5,6.0	No	No	GE	Yes	50&75	1.75
56	—	—	—	—	26	43.5	18	11	0.5	Self	13.2	—	Yes	2	WE	3	5.4	Yes	No	WE	Yes	—	3.0
57	—	—	—	—	5	35	0	60	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
58	—	—	—	—	20	70	0	10	—	Utility	—	—	—	—	—	—	—	—	—	—	—	—	—
59	—	—	—	—	30	20	45	5	—	Self	4.8[8], 6.3[9]	.94[8], 1.25[9]	Yes	6	MT	1.75	5.7	No	No	AC	Yes	1.5	1.75
60	20	—	—	—	70	30	—	—	—	Self	—	—	—	—	—	—	—	—	—	—	—	—	—
61	—	—	—	—	8	60	32	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
62	—	—	—	—	20	35	40	5	—	Utility	33	—	Yes	2	—	1.0	—	Yes	No	—	—	—	1.25
63	—	—	.11	.80	35	40	15	0	10	Utility	13.8	—	—	2	—	1.0	3	Yes	No	—	Yes	—	—
64	—	—	—	—	50	40	0	4	6	Self	27.6	.80	Yes	1	HH	0.75	—	Yes	No	EPD	Yes	—	1.5
65	—	—	12	.90	12	53	0	35	—	Self	24	—	Yes	3	PTD	1.5	5.2	No	No	—	—	—	2.5
66	35[4]	—	35	—	60	40	—	—	—	Utility	—	—	No	—	—	—	—	—	—	—	—	—	—
67	—	—	10	.85	30	70	—	—	—	Utility	41.6	—	Yes	5	GE, AC	—	—	Yes	No	ITE	—	—	64
68	—	—	—	—	9	55	11	16	9	Utility	13.8	18.6	Yes	3	MO	0.6	4.1	No	Yes	WE	Yes	—	—
69	—	—	—	—	5	25	5	65	—	Utility	12	—	No	3	LM	0.75	—	No	No	ITE	No	3.3	65

3 - Also 230-volt dc
4 - Emergency
5 - Looped secondary for welding
6 - Paper and lead
7 - And aluminum trough
8 - Old plant
9 - New plant
10 - 5-125 hp, 550 v; 125 hp-up, 4160 v
11 - Also 208/120
12 - All motors 10 hp & up have individual capacitors
16 - Combined load is 25%
A - Askarel
AB - Allen-Bradley Co
Ac - Aerial cable
Cc - Cable & conduit
D - Dry
Db - Direct burial
AC - Allis Chalmers Mfg Co
AWC - Anaconda Wire & Cable Co
BE - Benjamin Electric Mfg Co
BU - Bulldog Electric Products Co
CD - Cornell-Dubilier Electric Corp
CE - Columbia Electric & Mfg Co
CGE - Canadian General Electric Co Ltd
CH - Cutler-Hammer, Inc
CL - Curtis Lighting Inc
CON - Continental Electric Equipment Co
CR - Crouse-Hinds Co
CWC - Canadian Wire & Cable Co Ltd
CWE - Canadian Westinghouse Electric Corp
DB - Day-Brite Lighting, Inc
DP - Delco Products, Div, General
Div - Divided ownership
E - Electrolier Mfg Co Ltd
EEE - Electrical Engineers Equipment Co
EM - Electric Machinery Mfg Co
EP - Eastern Power Devices, Ltd
ES - Electro Silva-King Corp
ESC - The Electric Service Co, Inc
ET - Electric Tamper & Equipment Co of Canada Ltd
EU - Euclid Electric & Mfg Co
F - Fluorescent
FF - Fluorescent Fixtures of California
FP - Federal Pacific Electric Co
GC - General Cable Co
GE - General Electric Co
H - Holophane Co, Inc
HH - Hackbridge & Hewittic Electric Co of Canada Ltd

# of typical industrial plants, institutions

GENERATOR(S) NEW UNITS Voltage, v	Kva	PF	Manufacturer	Total generating capacity, kva	PRIMARY DISTRIBUTION (ABOVE 600 V) Circuitry	Voltage, kv	Overhead or underground	Distribution mains	Cable mfr	SECONDARY SUBSTATIONS Unit sub mfr	TRANSFORMER Transformer type	Manufacturer	Secondary voltage v	Auto volt reg	SECONDARY DISTRIBUTION Means	Manufacturer	PLANT LIGHTING Type	Fixture mfr	277 v	UTILIZATION MOTOR VOLTAGE 5-200 hp	201-2000 hp	2001-upward	Total motor hp	Motor mfr	MOTOR CONTROL Centralized or local	Control mfr	Capacitors, kvar	Manufacturer	Project Number
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Ia,Cc	PD	—	—	—	550[3]	—	—	2900	Zn	Loc	AB,GE,WE	—	—	11
—	—	—	—	—	Rd,Ps,N	4.5	Under	Cc	Var	—	O,D,A	Var	208,480	No	—	—	—	—	Yes	—	—	—	—	—	—	—	—	12
—	—	—	—	—	Rd,Ps	12	Under	Cc	OK,RS	GE,WE	Oil,Dry	GE,WE	480	No	Pib,Cc	Var	F	SH,DB,FF	Yes	480	2300	4160	12000	US,WE,GE	Loc	ZM	—	—	13
13.8	19,531	.8	GE	—	Rd	13.8	Over	Ia	—	WE	A	WE	550	No	—	—	F	—	—	—	—	—	—	—	—	—	—	—	14
—	—	—	—	—	—	—	—	—	—	—	Oil	—	480	No	Cc	—	F,Mv	H,MC,KE	No	480	—	—	320	Var	Loc	SD	—	—	15
—	—	—	—	—	Rd,Ps	—	Over	Ac	—	GE	Oil	GE	460	No	Var	GE	F	WF	Yes	440	—	—	2000	GE	Loc	GE	—	—	16
—	—	—	—	—	Ps	2.3	Over	Ia	GC	WE	Dry	WE	460	No	Pib,Ia,Cc	GC	F,Mv	MC	No	460	—	—	700	WE,GE	Loc	WE,GE	6200	WE	17
—	—	—	—	—	Rd	4.16	Under	Cc	CGE,CWC	CGE	Oil	CGE	600	No	Cc	CGE	F,I,Mv	BE,CR,DB	No	550[10]	4160[10]	—	8700	CGE,ET	Cen	CWE,CGE	—	—	18
—	—	—	—	4500	Ps	13.8	Over	Ac	—	GE	Oil	GE	480	No	Cc	—	F,I,Mv	Var	No	480	2300	—	3500	GE,WE	Cen	SD,WE,GE	750	—	19
4.16	7,500	.80	GE	7500	Rd	4.16	Over	Ac	—	WE	Dry	WE	480	No	Tc	Var	Mv	—	No	480	4160	—	20000	Var	Cen	WE	2160	WE	20
—	—	—	—	—	Rd[5]	13.8	Under	Ia[6]	KC,GE	AC	A	AC	480	No	Pib,Tc	GE	F,Mv	BE	No	480	2400	—	50000	ZI	Both	Zk	4500	SE,GE	21
—	—	—	—	8100	—	—	—	—	—	—	—	—	—	—	—	—	I	SM	—	—	—	—	—	—	—	—	250	CD	22
—	—	—	—	0	Rd	—	Over	Cc	—	AC	Dry	AC	440	No	Pib	SD	F	DB	Yes	440	—	—	750	LA,US	Loc	SD	—	—	23
—	—	—	—	0	—	5	Under	Cc	—	WE	Dry	—	480[11]	No	Pib,Cc	NE,GE	F,I,Mv	SY,H,FF	Yes	440	4160	—	—	Var	Loc	Var	—	—	24
—	—	—	—	4300	—	—	—	—	—	—	—	—	—	—	—	—	F,Mv	SY	—	480	—	—	1200	Var	Loc	SD	—	—	25
2300	850	.80	WE,GE	—	—	—	—	—	—	—	—	—	—	—	—	—	F,I	GE	No	(2300-4160)	—	—	4000	GE,WE,AC	Loc	WE,GE	1250	WE,GE	26
480	625	.80	EM	625	Loop	12.4	Under	Cc	PD	GE	A	GE	480	No	Pib	GE,WE	F,I,Mv	—	No	480	2300	—	—	—	Cen	GE,WE	500	GE,WE	27
—	—	—	—	—	Ps	4.16	Under	Db	OK	WE	Oil,Dry	WE	480	No	Tc	OK	—	DB,SM	Yes	480	—	—	2200	Var	—	SD,WE	—	—	28
—	—	—	—	—	Rd	4.16	Under	Cc	SW	GE	A	GE	4,160	No	Cc	GE	I	BE	No	440	—	—	—	GE	Loc	GE	—	—	29
—	—	—	—	—	Ps	6.9	Under	Cc	HC	WE	Oil	WE,PTD	240	No	Ac	GE	—	—	—	240	—	—	775	GE	Cen	GE	138	SE	30
—	—	—	—	—	Loop	12	Over	Cc	—	WIE	Dry	—	440	—	Pib	BU	Mv	—	Yes	440	—	—	—	—	—	—	—	—	31
—	—	—	—	—	Ps	4.16	Over	Cc[7]	KA	WE	Dry	WE	480	No	Tc	KA	F,Mv	MC	Yes	480	4160	—	3800	EM,AC,GE	Both	CH,AB	—	—	32
—	—	—	—	—	Rd	4.6	—	Cc,Ia	GE	WE,GE	A	WE,GE	480	No	Cc	—	F	WE	Yes	480	4600	—	8000	Var	Loc	Var	800	WE	33
—	—	—	—	1500	—	—	—	—	—	—	—	—	—	—	—	—	F	WE	—	480	—	—	—	—	—	—	—	—	34
—	—	—	—	—	Network	4.16	Under	Cc	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	35
—	—	—	—	—	—	5	Over	Ia	—	GE	Oil	GE	600	—	Cc	—	F	DB	—	600	—	—	3000	GE,WE	Cen	WE	500	WE	36
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	F	ES	Yes	460	—	—	500	AC,GE,WE	Loc	SD,GE,CH	—	—	37
—	—	—	—	—	Rd	13.2	Under	Cc	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	38
—	—	—	—	—	Ps	4.16	Under	Cc,Ia	PD	GE	Dry	GE	480	No	Pib,Ia,Cc	GE,PD	F	WE,LI	Yes	480	2300	—	—	Var	Both	SD,AB,CH	—	GE	39
4160	1,250	0.8	EP	4160	Rd	4.16	Under	Cc	Var	—	—	—	480	—	Pib,Cc,Tc	Var	F,I	Var	Yes	480	480	—	4000	Var	Both	EU	—	—	40
—	—	—	—	—	Rd	4.16	—	—	—	GE	Oil	GE	440	No	Cc	—	F,I	—	No	440	4160	—	4000	GE,WE	—	AB,CR	—	—	41
—	—	—	—	—	Ps	12	—	Cc	GC	GE	A	GE	480	No	Pib	GE	F	DB	Yes	480	—	—	900	Var	Both	Var	—	—	42
—	—	—	—	—	—	—	Under	Cc	FP	FP	Dry	—	—	—	Pib,Cc	—	F	Var	Yes	440	—	—	500	Var	Loc	Var	—	—	43
—	—	—	—	—	Rd	13.8	Under	Cc	AWC	ITE	D,A	ITE	480[11]	No	Pib,Ia	GE	F,I,Mv	BE	Yes	220,440	—	—	2000	Var	Both	Var	—	—	44
2500C	100	.85	GE	200	Rd	6.9	Over	Ac,Cc	Var	GE	Dry	—	480	No	Pib,Cc	Var	F,I	DB	Yes	480	—	—	—	Var	Loc	GE,BU	500	GE	45
4160	5,720	.70	WE	5720	Network	4.16	Over	Ac	GE	—	A	GE,ESC	440	No	Cc	GE	F,I	GE	Yes	440	440	—	4000	Var	Cen	GE	—	—	46
—	—	—	—	—	—	—	—	—	—	WE	A	WE	480	No	Pib,Ia,Cc	GE	F,I	MC,SY,WF	No	480	—	—	1500	Var	Loc	SD	360	WE	47
—	—	—	—	—	Rd	12	Over	Cc	GC	AC	Dry	AC	480	No	Pib,Cc	Var	F,Mv	WE,H	Yes	480	—	—	2400	GE,WE,LA	Loc	GE,AB,SD	—	—	48
4160	3,125	.8	EM	6562	Rd	4.16	Under	Cc	OK	ITE	Dry	—	480	No	Cc	—	F,I	—	—	—	—	—	—	—	—	AB	—	—	49
—	—	—	—	—	—	12	Under	Ia	RC	—	Dry	WE,GE	460	No	Cc	Var	F	MC	Yes	208	440	—	2000	Var	Loc	—	—	—	50
EMERGENCY	—	—	—	—	Ss	4.16	Under	Ac,Cc	WE,OK	Var	Oil	AC	440	No	Pib,Cc	NE	F,I	GE,CE	Yes	440	—	—	3000	AC,GE	Cen	GE,AC	—	—	51
—	—	—	—	—	Ps	1.5	Under	Cc	K	GE	A	GE	440	No	Pib	WE	F,I	Var	No	440	—	—	200	Var	Cen	WE	—	—	52
—	—	—	—	—	—	0.44	—	Db	AWC	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	53
—	—	—	—	—	Rd	2.4	Under	Cc	GE	GE,WE	Oil	—	480[11]	No	Cc	GE	F,I,Mv	Var	Yes	480	2400	—	700	GE,WE,DP	Both	WE,AB	135	GE	54
—	—	—	—	—	Ss	12	Over	Ac	GE	—	—	—	—	—	Ia,Cc	GE	F,I	GE,CL,H	No	480	—	—	1950	GE,WE,US	Both	GE	—	GE	55
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Pib	WE	F	—	Yes	480	480	—	800	Var	Both	Var	—	—	56
—	—	—	—	—	—	—	—	—	—	—	A	MT	240	No	Pib,Ia	BU	F,I	—	No	240	—	—	—	GE,US,ST	Loc	—	—	—	57
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Pib,Cc,Tc	BU	F	GE,WE,HO	No	220	—	—	600	Var	Loc	AB,SD	—	—	58
—	—	—	—	—	—	8.3	—	Ia	GE	Self	Dry	MT	480	No	Pib	BU	F	WE	—	480	—	—	1500	Var	Loc	BU	45	WE	59
—	1,250	.8	WO	2500	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	60
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Pib	—	F,I	BE	—	440	—	—	3000	GE,WE,DP	Loc	AB,SD	—	—	61
—	—	—	—	—	None	—	—	—	—	None	—	—	—	—	Pib,Ia	GE	F,I,Mv	—	No	440	—	—	1500	Var	Loc	Var	—	—	62
—	—	—	—	—	Rd	—	—	—	—	—	—	—	—	—	Pib,Cc,Tc	Var	F,I	—	No	480	—	—	—	—	Loc	AB	—	—	63
—	—	—	—	—	—	2.76	Under	Db,Cc	NE	—	—	—	—	—	Pib,Cc,Tc	NE	F	WIE,E	—	550	—	—	600	Var	Loc	SD,WE,GE	—	—	64
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Pib	BU	F,Mv	SM,DB	No	480	—	—	445	Var	Loc	SD,AB,GE	—	—	65
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	F,I	Var	No	240	—	—	—	—	Loc	—	—	—	66
—	—	—	—	—	—	—	—	—	—	—	—	—	230	No	Cc	—	F,I	DB	No	230	—	—	550	Var	Loc	AB	—	—	67
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	F	WE,CL,LC	No	440	—	—	700	Var	Loc	Var	—	—	68
—	—	—	—	—	—	0.44	Under	Cc	—	—	Oil	RW	110	No	Cc	—	I	CR	No	440	—	—	600	Var	Both	CH,RW	—	—	69

HC - Habirshaw Cable & Wire Corp
HO - House O-Lite Corp
I - Incandescent
Ia - Interlocked armor
ITE - I-T-E Circuit Breaker Co
K - Kerite Co
KA - Kaiser Aluminum Co
KC - Kennecott Copper Co
KE - Keystone Electric Mfg Co
LA - The Louis Allis Co

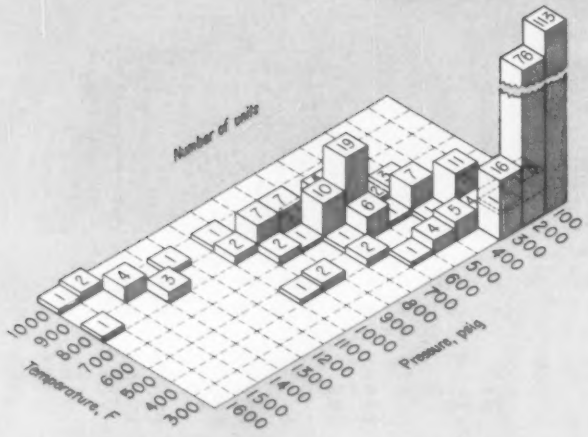
LC - Lightcraft Corp
LI - Lightolier, Inc
LM - Line Material Co
MC - The Miller Co
MO - Moloney Electric Co
MT - Marcus Transformer Co, Inc
Mv - Mercury-vapor
NE - National Electric Products Co
O - Oil
OK - The Okonite Co

PD - Phelps Dodge Copper Products Corp
Pib - Plug-in busway
Ps - Primary selective
PTD - Pennsylvania Transformer Div, McGraw-Edison Co
RC - Rome Cable Corp
Rd - Radial
RS - J A Roebling's Sons Corp
RW - Rowan Controller Co
SD - Square D Co

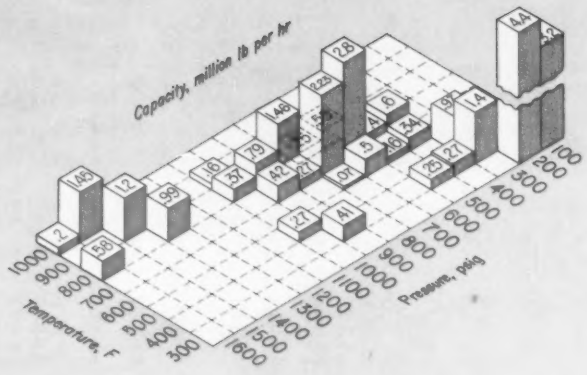
SE - Sprague Electric Co
SH - Smoot Holman Co
SM - Steber Mfg Co
Ss - Secondary selective
ST - Sterling Electric Motors, Inc
SW - Simplex Wire & Cable Co
SY - Sylvania Electric Co
Tc - Trough & cable
UP - R E Uptegraff Mfg Co Inc
US - U S Electrical Motors, Inc

Var - Various
WE - Westinghouse Electric Corp
WIE - Wilson Electric Co
WF - Wheeler Reflector Co, Div of Franklin Research Corp
WO - Worthington Corp
ZI - GE, WE, EM, RE, AC
Zk - SD, GE, Clark, CH

TODAY'S STEAM CONDITIONS

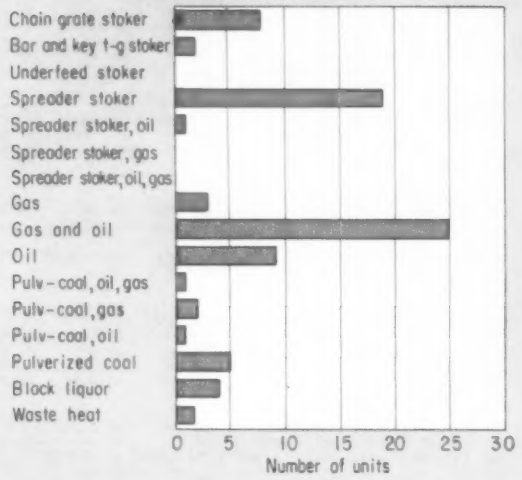


TOTAL REPORTED SALES of boilers during 1957 and first quarter of 1958 show a 23% decline over previous 16-month period



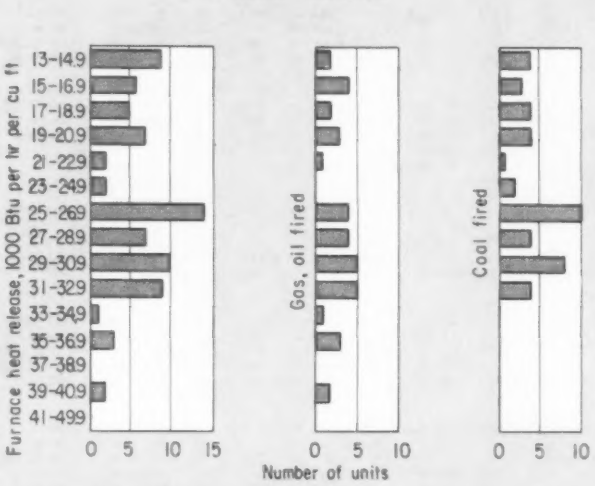
TOTAL CAPACITY decreased by 36%, due chiefly to unusually high-capacity single units installed during previous survey

FIRING METHODS



GAS AND OIL combination burners move far in front of single-fuel units. Spreader-stokers reflect an impetus in coal firing

HEAT RELEASE

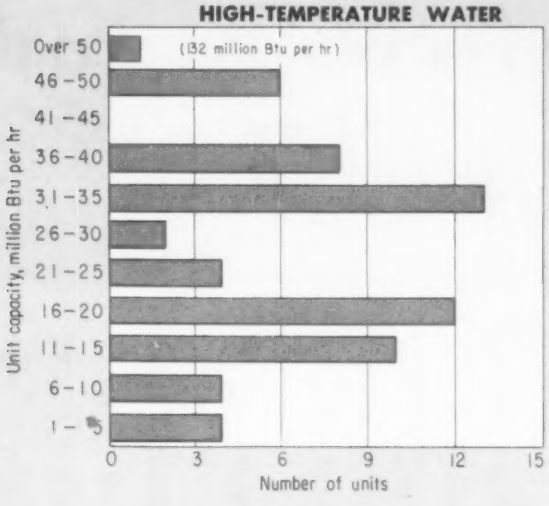


COAL FIRING takes the lead in heat-release rates, though gas and oil run a close second. The other fuels continue to vary.

INDUSTRIAL PLANT: growth paces economy

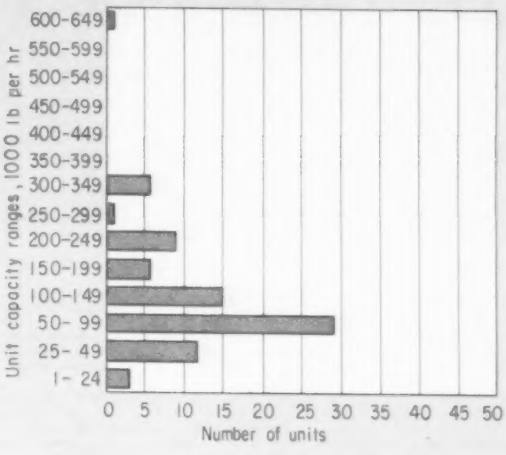
As the above charts indicate, there was a moderate decline in boiler and turbine capacity during the 16-month period covered by this survey. Some might say it offered a brief pause for planning until production needs hit an upturn. One thing is sure: Today's economic picture promises more new plants, further expansion, extensive modernization.

HIGH-TEMPERATURE WATER



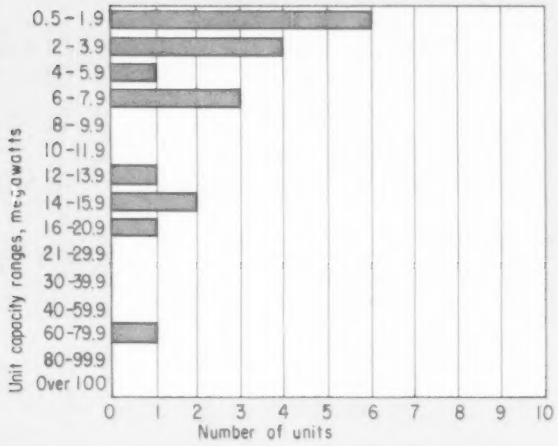
HIGH-TEMPERATURE-WATER boilers, totaling almost 1.7-billion Btu per hr capacity, show an increasing use of such systems

BOILER SIZES



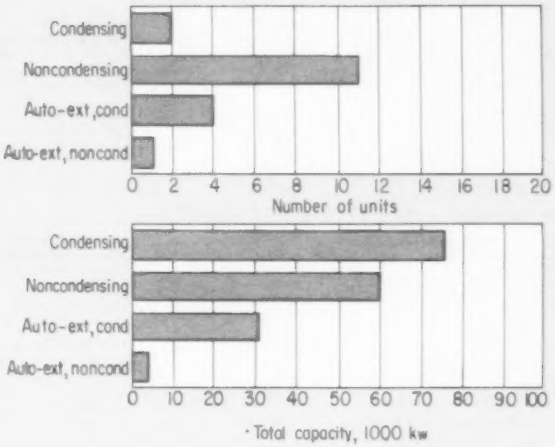
SMALL BOILERS, excluding separately tabulated packaged units, continue to supply majority of heat and process-steam needs

TURBINE SIZES



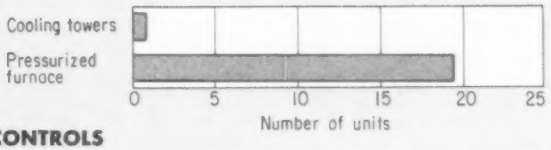
SMALLER TURBINES still lead. Larger installations, though spotty, are enough to uphold last year's trend to higher capacities

TURBINE TYPES

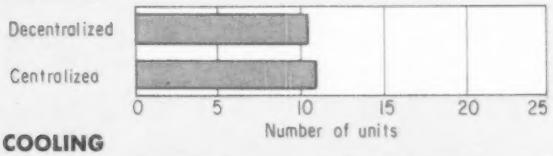


NONCONDENSING machines head total units, a reversal of trend to auto-ext condensing. Straight condensing still gives most kw

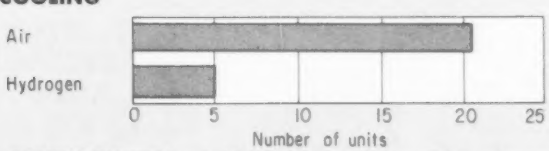
PLANT FEATURES



B-T CONTROLS

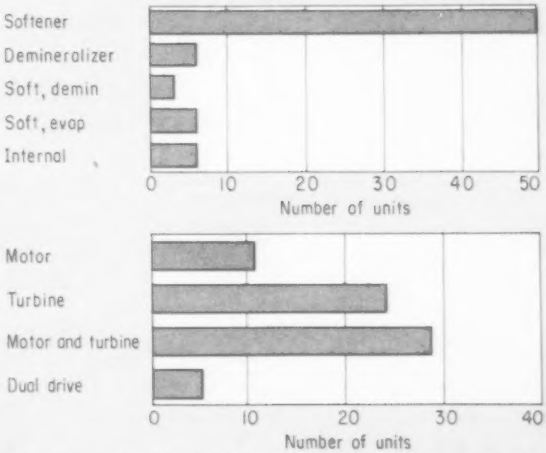


GEN COOLING



COOLING TOWERS lag behind last year. Pressure firing, generator cooling trends remain. Boiler-turbine control schemes even up

FEED TREATMENT — FEED-PUMP DRIVE



SOFTENERS take big lead in feedwater-treatment methods. Motor and turbine remain as first choice in feed-pump drives

1958 design survey: typical industrial

Note that each listing covers 4 pages. Project number helps you track a specific installation after turning facing page

Project Number	Company	Location	Consulting Engineers	New or existing plant	Date of initial operation	Principal steam use	BOILERS: Oper press, psig	BOILERS: Oper steam temp, F	BOILERS: Number new units	BOILERS: Manufacturer	BOILERS: Capacity each, 1000 lb per hr	SURFACE, 1000 SQ FT: Boiler and waterwalls	SURFACE, 1000 SQ FT: Economizer	SURFACE, 1000 SQ FT: Superheater	SURFACE, 1000 SQ FT: Air heater
1600 TO 801 PSIG															
1	Kennecott Copper Corp	Magna, Utah	Kuljian Corp	Ex	1-60	Po	1525	1010	1	CE	600	14.65	18.2	32.3[1]	151
2	Great Northern Paper Co	Millinocket, Maine	Stone & Webster Engr Corp	New	1-58	Po,Pr	1300	855	2	CE	330	17.0	.....	10.4	68.1
3	Great Northern Paper Co	Millinocket, Maine	Stone & Webster Engr Corp	New	3-58	Po,Pr	1300	855	1	CE	330	17.0	.....	10.4	68.1
4	Fraser Companies Limited	Edmundston, N.B., Canada	H.G. Acres & Co Ltd	Ex	6-58	Po,Pr	1250	950	1	CES	220	4.9	.....	.....	36.3
5	Abitibi Corp	Alpena, Michigan	Stone & Webster Engr Corp	New	.....	Po,Pr	900	825	2	BW	80	8.6	5.8	1.27	.....
6	Texas Co	Port Arthur, Texas	Jackson & Moreland	New	1-58	Po,Pr	900	750	3	RS	300	31.0	.....	4.26	26.3
7	Brown Company	Berlin, N.H.	Jackson & Moreland	.....	6-57	Po, Pr	885	775	1	CE	225	18.0	.....	.....	30.6
8	Container Corp of America	Fernandina Beach, Florida	Reynolds, Smith & Hill	.....	8-57	Po, Pr	875	825	1	BW	138	25.0	5	5	.....
9	Bowaters Carolina Corp	Catawba, South Car	United Engrs & Constructors, Inc	.....	1959	Po	850	825	1	BW	308	37.0	6.8	14.5	8.25
10	Hammermill Paper Co	Erie, Pa	Rust Engineering Co	Ex	8-59	Pr	675	760	1	RS	206	22.5	5	.....	13.4
11	Texas Company	Anacortes, Wash	Bechtel Corp	New	1958	Pr	650	700	2	EC	225	23.0	.....	2.7	8.8
12	Texas Company	Anacortes, Wash	Bechtel Corp	New	1958	Pr	650	700	1	BW	225	21.0	11	.....	.....
13	Southland Paper Mills, Inc	Lufkin, Texas	.....	.....	10-58	Po	635	765	1	CE	150	15.9	.....	.....	15.1
14	Canada and Dominion Sugar Co., Ltd	Toronto, Canada	H. G. Acres & Co Ltd	New	1958	Po,Pr,Sh	625	750	1	BWG	100	15.2	.....	2.24	23.3
15	East Texas Pulp and Paper Co	Evadale, Texas	H. A. Simons	Ex	10-58	Pr	625	750	1	CE	243	30.7	10.1	12.3	14.7
16	Charles Pfizer & Co	Groton, Conn	Laramore, Douglass and Popham	Ex	4-59	Pr	625	750	1	CE	165	16.2	.....	.....	10.0
17	Southland Paper Mills, Inc	Herty, Texas	.....	.....	10-58	Po,Pr	625	750	1	CE	83.5	12.7	8.25	4.48	5.13
18	Standard Oil Co (Indiana)	Neodesha, Kansas	.....	Ex	8-58	Pr	625	710	1	VO	175	14.6	.....	2.69	10.0
600 TO 401 PSIG															
19	Deere & Co	Moline, Ill	.....	New	11-58	Po,Pr,Sh	600	750	1	RS	135	17.0	6.7	.....	.....
20	Deere & Co	Moline, Ill	.....	New	11-58	Po,Pr,Sh	600	750	1	RS	135	17.0	6.7	.....	.....
21	Manchester Board & Paper Co	Richmond, Va	Blackburn, Brown & Blaurelt	Ex	3-58	Po,Pr	600	700	1	BW	65	6.7	.....	.....	.....
22	Northwest Paper Co	Brainerd, Minn	.....	Ex	11-58	Pr	600	750	2	BW	75	15.6	.....	.....	5.28
23	Odessa Butadiene Co	Odessa, Texas	Fluor Corp	New	9-57	Po,Pr	600	750	2	VO	130	13.0	.....	2.03	.....
24	Vickers Petroleum Co	Potwin, Kansas	Procon	New	6-58	Pr	600	486	1	VO	12	1.53	.....	.....	.....
25	Corn Products Refining Co	Pekin, Illinois	Sargent & Lundy	.....	7-59	Po	450	580	1	CE	270	21.7	.....	1.9	40
26	Rath Packing Co	Waterloo, Iowa	Helmick & Lutz	Ex	9-57	Po,Pr	450	750	1	WI	125	20.0	.....	2.6	21.4
27	Suntide Refining Co	Viola, Texas	.....	Ex	8-58	Pr	450	625	1	VO	85	8.75	.....	0.58	.....
28	Union Starch & Refining Co	Granite City, Ill	Rogers-Schmidt Engr Co	Ex	7-59	Po,Pr	450	750	1	VO	125	15.6	6.45	.....	.....
29	Florida State Hospital	Chattahoochee, Florida	Reynolds, Smith & Hill	Ex	3-59	Po	425	575	1	RS	60	7.2	.....	.....	5.8
30	St. Regis Paper Co	Sartell, Minn	Pfeifer & Schultz	Ex	1-58	Po,Pr	415	750	1	WI	90	15.2	.....	1.62	2.01
400 TO 200 PSIG															
31	Algoma Steel Corp, Ltd	Sault Ste. Marie, Ont., Can	Arthur G. McKee & Co of Canada	Ex	11-58	Po	400	750	1	FWL	175	29.3	.....	.....	11.5
32	Utah Oil Refining Co	Salt Lake City, Utah	Stearns-Roger Mfg Co	Ex	5-58	Po	310	540	1	BW	138	14.9	5.58	9.34	.....
33	Callery Chemical Co	Muskogee, Okla	Ralph M. Parsons Co	New	9-58	Po,Pr	300	472	3	WI	150	14.5	.....	.....	11.0
34	Carthage Paper Makers Inc	Carthage, N.Y.	Zack C. Hinds	Ex	1-58	Po,Pr	300	475	1	BW	50	5.6	3.7	0.38	.....
35	Mead Johnson & Co	Evansville, Indiana	.....	Ex	.....	Pr	300	Sat	1	CE	65	9.09	.....	.....	.....
36	United States Rubber Co	Chicopee Falls, Mass	.....	Ex	12-58	Pr	300	Sat	1	RS	90	10.7	2.6	.....	.....
37	General Tire & Rubber Co	Wabash, Indiana	J. A. Young Co	Ex	11-57	Pr	250	Sat	1	BW	40	.....	.....	.....	.....
38	Owens-Illinois Glass Co	Bridgeton, New Jersey	.....	Ex	10-58	Pr	250	460	1	RS	70	10.0	2.25	0.4	.....
39	United States Plywood Corp	Roseburg, Oregon	.....	.....	3-58	Pr	250	500	1	K	147	.....	.....	.....	.....
40	St. Olaf College	Northfield, Minnesota	.....	.....	4-58	Po	240	450	1	RS	50	5.95	.....	.....	.....
41	Hawthorden States Hospital	Macedonia, Ohio	.....	Ex	4-58	Po,Sh	235	401	2	BW	30	10.8	.....	.....	.....
42	Owens-Corning Fiberglass Corp	Newark, Ohio	.....	Ex	1-58	Pr	235	550	1	RS	40	5.0	9.0	.....	.....
43	Marquardt Aircraft Company	Ogden, Utah	.....	Ex	10-58	Sh	220	370	1	CE	12[18]	1.1	.....	.....	.....
44	R. J. Reynolds Tobacco Co	Lexington, Kentucky	Stone & Webster Eng Corp	New	8-58	Pr,Sh	220	395	3	EC	40	4.55	.....	.....	.....
45	Inland Empire Paper Co	Millwood, Washington	.....	Ex	.....	Po	200	Sat	1	CE	100	9.92	.....	.....	7.0
199 TO 126 PSIG															
46	University of New Hampshire	Durham, New Hampshire	Jennison Co	Ex	10-58	Sh	195	Sat	1	BW	39	4.83	.....	.....	.....
47	Farmers Union Central Exchange	Laurel, Montana	.....	.....	3-58	Pr	175	Sat	1	VO	200	.....	.....	.....	.....
48	Grain Processing Corp	Muscatine, Iowa	.....	Ex	10-58	Pr	170	Sat	2	SP	90	8.5	2.6	.....	.....
49	R. J. Reynolds Tobacco Co	Stokes County, North Carolina	Stone & Webster Engr Corp	New	.....	.....	170	375	3	BW	70	7.73	.....	.....	6.75
50	Donnacona Paper Co	Donnacona, Quebec, Canada	.....	Ex	9-58	Pr	165	500	1	FW	122	11.8	.....	.665	12.0
51	Midwest Manufacturing Co	Galesburg, Illinois	.....	.....	.....	.....	165	366	1	BW	50	6.26	.....	.....	.....
52	Canal Randolph Corp	Chicago, Illinois	Brooke & Choporis	Ex	.....	Sh	160	338	3	BW	30	3.72	.....	.....	.....
53	Norton Co, Behr-Manning Div	Troy, New York	J. O. Ross	Ex	9-57	Pr,Sh	150	367	1	IBW	132[18]	.....	.....	.....	.....
54	E. I. DuPont deNemours & Co	Wilmington, Delaware	.....	.....	.....	Pr	150	Sat	1	FW	66	7.4	.....	.....	.....
55	Medical Center Steam Company	Chicago, Illinois	Stone & Webster Engr Corp	Ex	10-59	Sh	150	400	1	BW	90	10.23	4.19	.....	.....
56	Corning Glass Works	Corning, N.Y.	St. John, Platt & Carlson	Ex	10-58	Pr,Sh	145	400	1	UI	80	10.76	.....	0.22	6.09
57	Chance Vought Aircraft, Inc	Dallas, Texas	Zumwalt & Vinther	Ex	2-58	Pr,Sh	130	Sat	1	CE	60	7.60	.....	.....	.....
58	Chance Vought Aircraft, Inc	Dallas, Texas	Zumwalt & Vinther	Ex	9-58	Pr,Sh	130	Sat	2	EC	80	9.52	.....	.....	.....
125 TO 100 PSIG															
59	College of Medical Evangalists	Los Angeles, California	Less Kelly	Ex	10-57	Pr,Sh	125	Sat	1	BW	50	6.0	.....	.....	.....
60	Ford Motor Co	Indianapolis, Indiana	J.F. Prichard & Co	New	1-57	Sh	125	Sat	2	K	120	16.8	.....	.....	7.2
61	Ford Motor Co	Indianapolis, Indiana	J.F. Prichard & Co	New	1-57	Sh	125	Sat	1	K	60	8.3	.....	.....	3.6
62	Berkshire Hathaway Inc	New Bedford, Massachusets	.....	Ex	.....	Pr,Sh	120	Sat	1	BW	15	2.01	.....	.....	.....
63	University of Rochester	Rochester, New York	.....	Ex	10-57	Sh	120	Sat	1	BW	100	9.82	.....	.....	.....
64	Denison University	Granville, Ohio	Rutherford L. Stinard	Ex	.....	Sh	115	Sat	1	BW	50	8.01	.....	.....	.....
65	Atlantic City Hospital	Atlantic City, New Jersey	Pennell and Wiltberger	Ex	.....	Pr,Sh	100	Sat	1	K	16	.....	.....	.....	.....
66	Hamilton Watch Co	Lancaster, Penna	.....	.....	3-58	Pr,Sh	100	338	1	K	33	.....	.....	.....	.....

Bd - Balanced draft
BE - Bucket elevator
Be - Belt
BG - Gravity discharge bucket elevator
Bk - Bark
BL - Black liquor
Bu - Bulldozer
C - Coal, bituminous
CB - Chain & bucket
Cm - Coalmeter
CO - Carbon monoxide
Co - Conveyor
CS - Car shaker
DB - Dry bottom
El - Electrostatic
Ex - Existing plant or apparatus
Fl - Flight
G - Gas
Id - Induced draft
Me - Mechanical
MF - Mass flow
O - Oil
Pb - Pivoted bucket
PC - Pulverized bituminous
Pd - Pressurized
Po - Power
Pr - Process
Re - Regenerative
SC - Steam coil
Sh - Space heat
ST - Slag tap
STr - Scoop truck
Sw - Screw
Th - Track hopper
Tu - Tubular
WB - Wet bottom
Wh - Waste heat
AB - American Blower Div
AF - Areofin Corp
APr - Air Preheater Corp
AT - The Aerotec Corp
BM - Bailey Meter Co
BuE - Bucyrus-Erie Co
BV - Breslove Separator Co
BW - Babcock & Wilcox Co
BWG - Babcock-Wilcox & Goldie McCullough Ltd
CE - Combustion Engineering, Inc

and institutional power plants

Furnace volume 1000 cubic feet	Furnace heat release, 1000 btu per cu ft per hr	Furnace type	Air heater type	Air heater manufacturer	Dust collector	Dust collector manufacturer	Firing	Heating value 1000 Btu per lb	Stoker manufacturer	COAL HANDLING EQUIPMENT													Project Number
										Delivery method to plant site	Unloading equipment	Manufacturer	Stockpiling method	Manufacturer	Stockpile to in-plant storage	Manufacturer	Covered storage facility	Manufacturer	In-plant handling equipment	Manufacturer	Weighing Equipment	Manufacturer	
49.9	17.2	Bd,WB	Re	APr	Me	RC	PC,G	12.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
21.6	18.6	Bd	Re	APr	.....[3]	.....	O	14.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
21.6	18.6	Bd	Re	APr	.....[3]	.....	O	14.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
11.7	.....	Bd	Re	APr	Me	PD	PC	.....[5]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
3.69	2.9	Bd	.....	.....	Me	PD	C[9]	.....	DSC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
14.8	29.5	Pd	Re	APr	.....	.....	O,G	1.08[8]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
14.7	19.4	Bd,DB	Tu	.....	Me	.....	PC	12.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
19	12	Bd	SC	AB	El	KO	BL	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8
38.9	9.35	Bd,ST	SC	.....	El	.....	BL	4.28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9
12.1	26.6	Bd	Tu	RS	Me	HCC	C,Bk	.....	RS	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10
12.4	25	Pd	Re	APr	.....	.....	Wh,O,G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11
9.3	.....	Pd	Re	APr	.....	.....	Wh,O,G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
10.2	25	Bd	Tu	CE	Me	WP	G,Bk	1.0[8,9]	CE	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	13
6.83	19.6	Pd,DB	Tu,SC	BW,AF	Me	RC	PC	12.8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14
31.9	.....	ST	SC	AB	Ex	.....	BL	6.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
7.45	28.4	Bd	SC,Re	APr	Me	AT	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	16
13.3	.....	ST	SC	AB	.....	.....	BL	7.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17
8.76	26.0	Pd	Re	APr	.....	.....	O,G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	18
7.0	26.7	Pd	.....	.....	Me	WP	C	.....	RS	Rail	CS,Th	GI	Bu	Self	BE	GI	Bunker	GI	Be,BG	GI	Scale	SE	19
7.0	26.7	Pd	.....	.....	Me	WP	C	.....	RS	Rail	CS,Th	GI	Bu	Self	BE	GI	Bunker	GI	Be,BG	GI	Scale	SE	20
.....	.....	Bd	.....	.....	Me	PD	C	.....	DSC	Rail	Th	SA	Bu	IH	Mf,Be	SA	Bunker	SA	Mf	SA	Cn	BM	21
3.76	.....	Bd	Tu	BW	Me	WP	C	.....	DSC	Rail	CS,Th	.....	CB	.....	BE	LB	Silo	FE	BG	.....	.....	.....	22
.....	.....	Bd	Re	APr	.....	.....	G	0.55-1.08	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	23
0.36	40.2	Pd	.....	.....	.....	.....	O,G	18.5,1.0[8]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	24
20.4	15.4	Bd,DB	.....	.....	Me	.....	O,PC[12]	10.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
.7	18	Bd	Tu	WI	Me	WP	G,PC	.....	.....	Rail	.....	.....	.....	.....	Be,BE	.....	Bunker	.....	Be	.....	Scale	SE	26
3.18	35	Bd	.....	.....	.....	.....	G	1.08[8]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	27
5.7	.....	Bd	.....	.....	Me	HCC	C	11.2	HCE	Truck	Th	.....	.....	.....	Sw,BE	.....	.....	.....	Sw,BG	.....	Cn	BM	28
3.3	25	Bd	Tu	RS	Me	.....	PC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29
4.6	24.9	Bd	Tu,SC	WI	Me	WP	C	12.2	DSC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30
.....	.....	Bd	Tu	FWL	.....	.....	.....[13]	.....[14]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31
6.0	32.5	Pd	.....	.....	.....	.....	CO,O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32
9.4	19.0	Bd,DB	Tu,SC	WI,AB	.....	.....	O,G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33
2.45	25.4	Bd	.....	.....	.....	.....	C	.....	BW	Rail	Cb,Th	.....	CB	.....	BE	.....	Bunker	.....	BG	.....	Scale	FM	34
.....	.....	Bd	.....	.....	.....	.....	C	11.5	CE	Truck	Th	LB	Bu	.....	.....	.....	.....	.....	Be,PB	LB	Scale	KI	35
3.6	30.3	Bd	.....	.....	Me	WP	C	.....	RS	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36
.....	.....	Bd	.....	.....	.....	.....	C	11.8	BW	Rail	Th	FE	.....	.....	FI	FE	Silo	FE	Be	FE	Scale	FM	37
3.13	28.0	Bd	.....	.....	.....	.....	C	13.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	38
8.3	22.0	Bd	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39
2.5	27.1	Pd	.....	.....	.....	.....	O,G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
1.33	30.0	Bd	.....	.....	.....	BV	C	12.0	DSC	Truck	.....	.....	Bu	IH	BE,FI	FE	Bunker	SE	Be	FE	Scale	HS	41
.....	15.1	.....	.....	.....	Me	PD	PC	12.5	RS	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42
0.23	.....	Bd	.....	.....	.....	.....	O,G	0.875[8]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43
1.05	.....	Pd	.....	.....	.....	.....	O,G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	44
2.44	.....	Pd	R	APr	.....	.....	O,G	18.5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	45
1.26	38.8	Bd	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	46
.....	.....	Bd	.....	.....	.....	.....	O	18.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	47
.....	.....	Bd	.....	.....	Me	BV	C	.....	LS	Rail	CS,Th	SA	Bu	AC	Truck	.....	Silo	.....	BG	SA	Scale	TQ	48
2.68	31.2	Bd	Tu	BW	Me	WP	C	12.8	DSC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49
6.35	19.9	Bd	Tu,SC	CSL	Me	PD	PC	11.6	.....	Truck	Th	.....	Bu,CB	.....	BE	JM	Bunker[17]	.....	BG,Be	JM	.....	.....	50
.....	.....	Pd	.....	.....	.....	.....	C	.....	BW	Truck	Th	GC	.....	.....	BE	GC	Silo	.....	.....	.....	.....	.....	51
.....	.....	Bd	.....	.....	.....	.....	O,G	18.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	52
6.5	20.9	Bd	R	APr	Me	PD	PC	13.5	.....	Rail	Th	GI	.....	.....	.....	.....	Bunker	GI	Co,Be	GI	.....	.....	53
2.5	.....	Pd	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	54
3.8	27.8	Bd,DB	.....	.....	Me	.....	O,G,C	.....	BW	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	55
3.25	30.0	Bd	Tu	UI	Me	HCC	C	12.78	RS	Truck	Th	FM	Cb	BuE	STr	FGH	Bunker	LB	BG	.....	Scale	FM	56
2.26	35.0	.....	.....	.....	.....	.....	O,G	18.5,1.0[8]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	57
3.65	29.0	.....	.....	.....	.....	.....	O,G	18.5,1.0[8]	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	58
.....	.....	Id	.....	.....	.....	.....	O,G	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	59
5.8	25.0	Bd	Tu	K	Me	PD	C	12.0	HCE	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60
2.9	25.0	Bd	Tu	K	Me	PD	C	12.0	HCE	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61
.....	30.0	Bd,DB	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	62
.....	.....	Bd	.....	.....	.....	.....	C	13.5	BW	Rail	CS,Th	.....	Bu	.....	Be	.....	Bunker	.....	Be	.....	.....	.....	63
.....	.....	Bd	.....	.....	.....	.....	C	12.5	RS	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	64
.....	.....	Bd	.....	.....	.....	.....	O	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	65
1.23	31.5	Pr	.....	.....	.....	.....	C	.....	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	66

CES - Combustion Engineering Superheater, Ltd
CSL - Canadian Sirrocco Co Ltd
DSC - Detroit Stoker Co
EC - Erie City Iron Works
FE - Fairfield Engineering Co
FGH - The Frank G. Hough Co
FM - Fairbanks Morse & Co
FW - Foster Wheeler Corp
FWL - Foster Wheeler Ltd
GC - Godfrey Conveyor Co
GI - Gifford Wood Co
HCC - Hagan Chemicals & Control, Inc
HCE - Hoffman Combustion Engineering Co
HS - The Howe Scale Co
IH - International Harvester Co
JM - Jeffrey Mfg Co
K - E Keeler Co
KO - Koppers Company, Inc. Metal Products Div
LB - Link Belt Co
LS - Laclede Stoker Co
PD - Pratt-Daniel Corp
RC - Research-Cottrell, Inc
RI - Richardson Scale Co
RS - Riley Stoker Corp
SA - Stephans-Adamson Mfg Co
SE - Stock Equipment Co
SP - Springfield Boiler Co
TO - Toledo Scale Co
UI - Union Iron Works
VO - Henry Vogt Machine Co
WI - Wickes Boiler Co
WP - Western Precipitation Corp
1 - Reheater surface 6,330 sq ft
3 - Future mechanical
5 - Minto coal, 8500-10500 btu/lb
6 - Also cutting room waste
8 - 1000 Btu per cu ft
9 - Bark 4860 btu per lb
12 - Future gas
13 - Blast furnace gas principle fuel
14 - 90 btu per cu ft
17 - Cement, own design
18 - High temperature water, million btu per hr

continued

Compiled by:
R.C. Bellas & J.W. Follansbee, Assistant Editors

Design survey of typical industrial

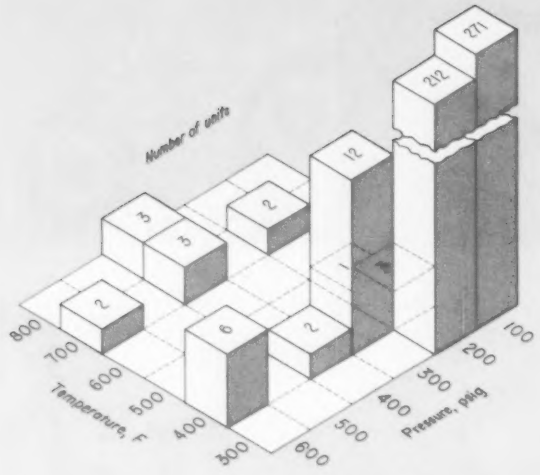
Project number	F.D. FANS			I.D. FANS			AIR & GAS FLOW CONTROL		SOOT BLOWERS			Ash handling system	Manufacturer	FEED WATER PUMPS					WATER TREATMENT				
	No., and drive	Fan mfr.	Drive mfr	No. and drive	Fan mfr.	Drive mfr.	Air flow	Gas flow	No. per boiler	Type	Manufacturer			No. per boiler	Pump mfr	Drive	Drive mfr	Pump control	Use	Flow rate	Softening	Demineralizing	Manufacturer
1	2 M	AB	GE	2 M	AB	GE	D,V	S,D	22	St	CV	Hyd	ASM	3	BPC	M	GE	R	Bf	60	HLZ	.....	AWS
2	1 M	GF	EL	1 M	SW	WE	D	D	14	St	DP	.....	.....	1	IR	T	GE	R	Bf[4]	600	Ca	Mu	IN
3	1 M	GF	EL	1 M	SW	WE	D	D	14	St	DP	.....	.....	1	IR	T	GE	R	Bf	600	Ca	Mu	IN
4	1 M	SW	.....	1 M	SW	.....	V	D	4	St	DP	Pn	UC	2	DL	T	WE	R	Bf	315	.....	Mu	P&SL
5	1 M	GF	WE	1 M	GF	WE	D	.....	1	St	DP	Pn	NC	1	DL	M	WE	R	Bf	.....	HLZ	.....	.....
6	T,Du	SW	EL	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....[7]	BJ	M,T,Du	EL	R	.....	2000	.....	Mu	COC
7	1 M	.....	.....	1 M	.....	.....	V	D	.....	.....	.....	Pn	.....	2	.....	M,T	.....	R	Bf	.....	.....	Mu	.....
8	1 T	SW	WE	.....	SW	WE	.....	S	11	St	DP	.....	.....	1	IR	T	WE	R	Bf	.....	HLZ	.....	COC
9	1 M	.....	.....	1 M	.....	.....	V	Hyd	.....	.....	.....	.....	.....	2	.....	M,T	.....	R	.....	.....	.....	.....	.....
10	1 M	SW	.....	1 M	BF	.....	V	D	2	.....	CV	Pn	UC	2	WO	2 M	.....	R	Bf	1760	HLZ	.....	COC
11	2 T	AB	WE	.....	.....	.....	V	V	14	St	CV	.....	.....	1	BPC	Du	WE	S,R	Bf	1600	CLZ	.....	.....
12	2 T	AB	WE	.....	.....	.....	V	V	14	St	CV	.....	.....	1	BPC	Du	WE	S,R	Bf	1600	CLZ	.....	.....
13	1 M	AB	AC	1 M	AB	AC	V	D	9	ST	DP	Pn	UC	1	IR	T	EL	S	.....	.....	.....	.....	.....
14	1 M	CBF	AC	1 M	.....	LDC	V	D	3	St	DS	Pn	TEC	2	CIR	M	CWE	R	.....	.....	Z^{10}	.....	P&SL
15	1 M	AB	GE	1 T	Ex	.....	D	D	.....	St	CV	.....	.....	Ex	.....	.....	.....	.....	Ex	.....	.....	.....	COC
16	1 T	SW	EL	1 T	SW	EL	D	D	10	St	DP	Pn	NC	.....	.....	M,T	LA,EL	R	.....	.....	.....	.....	.....
17	1 M	AB	AC	1 M	AB	AC	V	S	22	St	CV	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	1 M	AB	AC	.....	.....	.....	.....	.....	.....	.....	DP	.....	.....	.....	PP	T	TE	R	.....	.....	HLZ	.....	.....
19	1 T	GF	.....	.....	.....	.....	S,D	.....	.....	.....	.....	Pn	UC	3	BJ	M,T	.....	R	Bf	.....	HLZ	.....	.....
20	1 T	GF	.....	.....	.....	.....	S,D	.....	.....	.....	.....	Pn	UC	3	BJ	M,T	.....	R	Bf	.....	HLZ	.....	.....
21	1 M	CF	WE	1 T	PD	WE	D	.....	5	St	DP	Pn	UC	2	WP1	T	WE	S	.....	.....	.....	.....	.....
22	1 T	CF	EL	1 T	CF	EL	.....	S	2	St	DP	Pn	UC	1-1/2[11]	IR	IM,ZT	EL	S	Bf	150	HLZ	.....	IN
23	1 T	BF	TE	1 T	BF	TE	V	D	.....	.....	.....	.....	.....	1-1/2[11]	PP	3 T	EL,TE	R	Bf,Ct	.....	C&HLZ	.....	GW
24	1 M	KD	US	.....	.....	.....	Ec	D	1	.....	DP	.....	.....	2	UP	1 M	AC	R	Bf	.....	HLZ	.....	.....
25	1 M	.....	.....	1 M	.....	.....	D	D	.....	.....	.....	Hyd	.....	1	.....	T	.....	S	.....	.....	.....	.....	.....
26	1 Du	SW	EL	1 Du	SW	EL	S,D	S,D	.....	St	CV	Pn	UC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
27	.....	.....	.....	1 T	BF	EL	.....	D	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....
28	1 T	CF	EL	1 Du	SW	EL	V	D	7	St	BR	Pn	.....	3	IR	T	EL	S,R	Pr	1200	Ca,CLZ	.....	.....
29	1 M	SW	.....	1 M	SW	.....	D	D	4	St	DP	Me	BU	1	DL	T	TE	R	.....	.....	Ca,Z	.....	.....
30	1 M	CF	.....	1 Du	CF	EL	V	S,D	7	St	DP	Pn	UC	.....	.....	.....	.....	.....	Bf	.....	CLZ	.....	.....
31	1 T	CBF	WO	1 T	CBF	WO	V	D	3	St	CV	.....	.....	1	WO	T	WO	S	Ex	.....	.....	.....	.....
32	1 T	SW	EL	.....	.....	.....	S	.....	7	St	DP	.....	.....	2	IR	T	EL	S	Bf	200	HLZ	.....	COC
33	1 T	AB	EL	1 T	AB	.....	S,V	S,D	.....	.....	.....	.....	.....	1	WO	M,T	EM,WO	R	Bf	.....	Z	.....	.....
34	1 M	AB	GE	1 M	AB	GE	D	D	2	.....	DP	Pn	BB	2	GP	M,T	GE,TE	R	Bf	.....	.....	.....	.....
35	1 Du	CF	GE,EL	1 Du	PD	GE,EL	D	D	4	St	DP	Pn	UC	Ex	.....	.....	.....	.....	.....	.....	.....	.....	.....
36	1 Du	SW	WE	1 Du	SW	WE	.....	.....	4	St	DP	Pn	NC	.....	IR	M,T	GE,TE	.....	.....	.....	.....	.....	.....
37	1 M	AB	GE	.....	.....	.....	V	.....	2	.....	DP	Pn	UC	Ex	.....	.....	.....	.....	.....	.....	Ca	.....	COC
38	1 M	AB	AC	1 Du	CF	.....	D	D	11	St	DP	.....	.....	2	WO	T	WO	R	Bf	.....	.....	.....	.....
39	.....	BF	.....	.....	BF	.....	.....	.....	.....	.....	.....	.....	.....	2	WP1	M,T	.....	.....	Evap.	.....	.....	.....	PC
40	1 M	.....	.....	.....	.....	.....	V	.....	2	.....	CV	.....	.....	3	AC	M,T	.....	R	Bf	.....	.....	.....	AC
41	1 M	CF	GE	.....	.....	.....	V	D	2	St	DP	Pn, Hyd	UC	3	IR	M,T,Du	WE,GE	R	Bf	.....	Z	.....	.....
42	2 M	SW	.....	1 M	SW	.....	D	.....	.....	.....	.....	Me	PD	1	.....	T	.....	.....	.....	.....	Z	.....	.....
43	1 M	CF	US	.....	.....	.....	V	.....	2	Air	DP	.....	.....	2	PRP	.....	.....	.....	.....	.....	Z	.....	.....
44	1 M	LJW	RE	.....	.....	.....	.....	.....	1	St	CV	.....	.....	2[15]	AC	M,T	AC,TE	R	Bf	240	Z	.....	.....
45	1 M	CF	.....	.....	.....	.....	V	.....	3	Air	CV	.....	.....	Ex	.....	M,T	.....	.....	.....	.....	Z	.....	.....
46	1 M	CF	WE	.....	.....	.....	D	.....	2	St	DP	.....	.....	.....	DL	M,T	WE,DL	R	Bf	.....	.....	.....	EFD
47	.....	AB	.....	.....	AB	.....	.....	.....	.....	.....	.....	.....	.....	.....	WO	T	.....	.....	Bf	.....	.....	.....	IN
48	1 M	CF	LA	1 M	PD	LA	D	D	4	.....	BR	Me	.....	1	BJ	T	GE	S	Bf	.....	HLS	.....	.....
49	1 Du	GF	GE	1 Du	GF	GE	V	D	2	St	DP	Pn	.....	2[16]	IR	M,T	.....	.....	Bf	.....	Z	.....	.....
50	1 M	SW	GE	1 M	SW	GE	V	D	8	St	DP	Pn	BB,ASH	.....	CIR	M	.....	.....	Bf	.....	.....	.....	.....
51	1 M	AB	.....	.....	.....	.....	.....	.....	.....	St	DP	Me	GC	1	.....	T	.....	.....	Bf	90	Z	.....	.....
52	1 M	LJW	.....	.....	.....	.....	V	D	2	St	DP	.....	.....	1	WO	Du	.....	R	.....	.....	.....	.....	.....
53	1 M	SW	.....	1 M	PD	.....	.....	.....	.....	St	DP	Pn	UC	3	IR	M	GE	.....	.....	.....	.....	.....	.....
54	1 M	CF	.....	.....	.....	.....	D	.....	2	St	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
55	1 M	.....	.....	1 M	.....	.....	D	.....	13	St	DP	Pn	UC	Ex	.....	.....	.....	.....	.....	.....	.....	.....	.....
56	1 M	CF	EL	1 M	CF	EL	D	D	8	St	DP	Pn	UC	1-1/2[11]	IR	M,T	ME,TE	.....	Bf	80	Z^{18}	.....	PC
57	.....	.....	.....	1 M	PD	LA	D	.....	.....	.....	.....	.....	.....	1	AC	T	TE	.....	Bf	.....	.....	.....	.....
58	.....	.....	.....	1 M	PD	EL	D	.....	.....	.....	.....	.....	.....	1	AC	M	AC	.....	Bf	.....	.....	.....	.....
59	.....	.....	.....	1 M	BF	GE	.....	.....	2	St	.....	.....	.....	1	PP	M	.....	.....	Bf	100	Z	.....	.....
60	1 Du	AB	GE,TE	1 Du	AB	GE,TE	V	D	8	.....	CV	Pn	UC	1	BP	M,T	HEM	R	Bf	180	Ca,HLZ	.....	PC
61	1 Du	AB	GE,TE	1 Du	AB	GE,TE	V	D	.....	.....	.....	Pn	UC	1	BP	T	TE	R	Bf	180	Ca,HLZ	.....	"
62	1 T	LJW	LJW	1 T	AB	COP	S,D	S	2	St	DP	.....	.....	1[19]	IR	Du	COP,WE	R	Bf	.....	.....	.....	BLA
63	1 M	SW	.....	.....	.....	.....	D	.....	4	St	DP	.....	.....	.....[20]	.....	.....	.....	.....	Bf	.....	HLZ	.....	.....
64	1 M	CF	EL	.....	.....	.....	.....	.....	.....	.....	DP	Pn	UC	.....	.....	M,T	WE,WO	.....	Bf	.....	Z	.....	.....
65	1 M	PE	.....	1 M	LJW	.....	D	.....	1	St	K	.....	.....	1	WO	T	.....	.....	.....	.....	.....	.....	.....
66	.....	CF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	T	.....	.....	.....	.....	.....	.....	.....

A-e - Auto-extraction
Bf - Boiler feed
Bl - Bleeder
Ca - Coagulator
Cg - Condensing
Cen - Centralized
CLZ - Cold lime zeolite
Ct - Cooling tower
D - Damper control
Dec - Decentralized
Du - Dual drive
Ec - Electrical
H_2 - Hydrogen
HLS - Hot lime soda
HLZ - Hot lime zeolite
Hyd - Hydraulic
J - Steam jet
M - Motor drive
M_H - Multibed
N-C - Non-condensing
Pn - Pneumatic
Pr - Process
R - Regulator
S - Speed control
St - Steam
Su - Surface
T - Turbine drive
V - Vane control
Z - Zeolite
AB - American Blower Div
AC - Allis Chalmers Mfg Co
ASH - Allen-Sherman-Hoff Pump Co
AWS - American Water Softener Co
BB - Beaumont Birch Co
BF - Buffalo Forge Co
BJ - Byron Jackson Pumps, Inc
BLA - Betz Laboratories, Inc
BM - Bailey Meter Co
BML - Bailey Meter Co Ltd
BP - Buffalo Pumps, Div Buffalo Forge Co
BPC - Bingham Pump Co
BR - A J Bayer Co
BU - Buell Engineering Co, Inc
CBF - Canadian Blower and Forge Co, Ltd
CF - Clarage Fan Co
CGE - Canadian General Electric Co, Ltd
CIR - Canadian Ingersoll Rand Co, Ltd
COC - Cochrane Co
COP - Coppus Engineering Corp
CPT - Continental Products of Texas
CV - Copes-Vulcan Div, Blaw-Know Co
CWE - Canadian Westinghouse Electric Corp, Ltd
DCC - Dearborn Chemical Co
DL - De Laval Steam Turbine Co

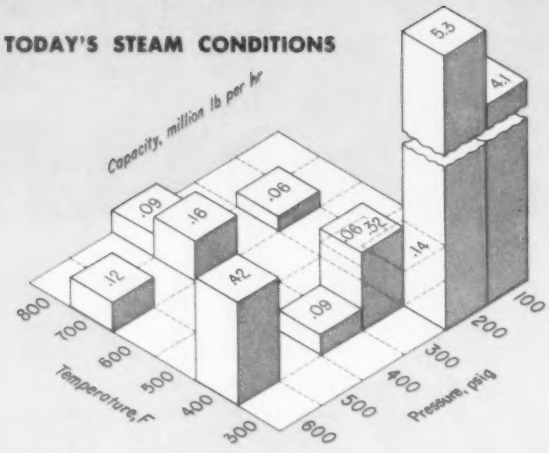
and institutional power plants

Internal treatment supplier	Combustion control	Control manufacturer	TURBINES: Number	Throttle press., psig	Throttle temp, F	Manufacturer	Capacity, 1000 kw	Type	RPM	Back pressure, psia	No. of bleed points	No. of auto-extraction points	Deaerating heater pressure, psig	Generator cooling	CONDENSERS: Type	Manufacturer	No. of water passes	Cooling water	Condensate air removal	Boiler controls	Total plant boiler capacity	Project number
.....	Pn	HCC	1	1450	1000[2]	GE	75	B1,Cg	3600	1.00	6	.....	49.6	H_2	Su	RHE	2	Well	J	Cen	1650	1
NA	Pn	BM	1	1250	855	GE	18.0	N-C	2400	225	.....	.....	40	.....	Su	IR	2	River	J	Cen	660	2
NA	Pn	BM	1	1250	855	GE	15.6	Cg	2400	0.75	.....	2	40	H_2	Su	IR	2	River	J	Cen	990	3
.....	Pn	BML	1	1250	950	WE	12.5	A-e,Cg	3600	.....	.....	2	25	Air	Su	CWE	2	River	J	Dec	420	4
.....	Pn	BM	1	850	825	GE	6.25	A-e,Cg	3600	.....	.....	1	15	Air	Su	EL	2	Lake	J	Cen	160	5
.....	.....	.....	1	850	750	GE	15.6	N-C	3600	190	.....	.....	15	H_2	.....	.....	.....	.....	.....	Cen	4035	6
.....	.....	.....	1	850	750	WE	6.0	N-C	3600	165	.....	.....	5	Air	.....	.....	.....	.....	.....	Dec	.....	7
.....	Ec	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	645	8
.....	.....	.....	1	850	900	GE	12.5	Cg	3600	1.25	1	1	50	Air	Su	.....	2	River	J	Cen	508	9
.....	Pn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	730	10
.....	Pn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cen	450	11
.....	Pn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cen	675	12
.....	Pn	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1285	13
DCC	Pn	BM	1	600	750	CGE	2.5	N-C	3600	35	.....	.....	20	Air	.....	.....	.....	.....	.....	Cen	100	14
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	650	15
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	555	16
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1245	17
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	425	18
.....	.....	.....	1	175	500	GE	3.0	A-e	3600	1.5	.....	2	5	Air	.....	.....	.....	River	J	.....	165	19
.....	.....	.....	1	400	750	GE	0.5	A-e	3600	1.5	.....	2	5	Air	Su	.....	2	River	J	.....	300	20
.....	Ec	HC	1	600	700	WE	2.0	N-C	3600	55	.....	.....	10	Air	.....	.....	.....	.....	.....	.....	130	21
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	22
CPT	Pn	BM	5	590	725	.....	.....	N-C,Cg	.....	.....	.....	.....	25	Air	Su	EL	2	Ct	J	Dec	260	23
.....	Ec	PE	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	133	24
.....	.....	.....	1	400	580	DL	7.5	N-C	3600	165	.....	.....	5	Air	.....	.....	.....	.....	.....	Cen	890	25
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26
.....	Pn	HCC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	510	27
NA	Pn	RF	1	400	750	GE	4.0	A-e	3600	20	.....	1	5	Air	.....	.....	.....	.....	.....	Dec	305	28
HCC	Pn	BM	1	400	575	WO	2.5	Cg	3600	1.25	.....	1	.....	Air	Su	EL	2	.....	J	Dec	220	29
AC	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	165	30
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Dec	465	31
HCC	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	658	32
BLA	Pn	BM	1	300	472	WO	0.5	N-C	1800	14.7	.....	.....	50	Air	.....	.....	.....	.....	.....	Cen	450	33
.....	.....	HCC	1	290	471	GE	0.75	N-C	3600	40	.....	.....	15	Air	.....	.....	.....	.....	.....	Dec	130	34
.....	Ex	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cen	210	35
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	260	36
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	80	37
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	105	38
.....	.....	HC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	39
HCC	Pn	.....	1	250	475	WO	0.5	N-C	4500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	80	40
.....	Pn	HCC	3	235	401	WE,WO	25,5	N-C	.....	5	.....	.....	5	.....	.....	.....	.....	.....	.....	Dec	120	41
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	42
HCC	Ec	PE	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2418	43
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	120	44
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	167	45
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	110	46
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	47
.....	Pn	HCC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	260	48
.....	Pn	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Dec	210	49
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	423	50
...	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	64	51
...	Hyd,Pn	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	100	52
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	53
.....	Pn	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	54
.....	Pn	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	360	55
EFD	Pn	HCC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	140	56
.....	Pn	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	60	57
.....	Pn	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	220	58
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70	59
.....	Pn	RF	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	240	60
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	900	61
...	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	47	62
.....	Pn	BM	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Cen	200	63
.....	Pn	HCC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	108	64
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	65
.....	Pn	HC	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	66

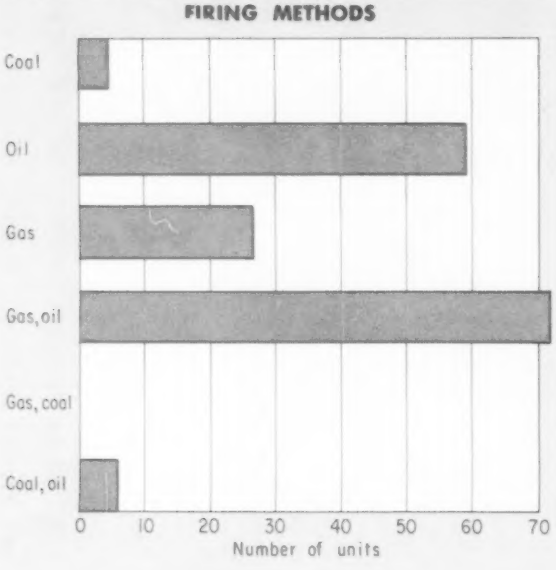
DP - Diamond Power Specialty Co
DS - Diamond Specialty Ltd
EFD - E F Drew & Co
EL - Elliott Co
EM - Electric Machinary Mfg Co
GC - Godfrey Conveyor Co
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GP - Goulds Pumps Inc
GW - Graver Water Conditioning Co
HC - The Hays Corp
HCC - Hagan Chemicals & Controls, Inc
HEM - Howell Electric Motors Co
IN - Infilco, Inc
IR - Ingersoll-Rand Co
K - E. Keeler Co
KD - Kalamazoo Div, The New York Air Brake Co
LA - The Louis Allis Co
LDC - Lancashire Dynamo & Crypto
LJW - L J Wing Mfg Co
ME - Marathon Electric Mfg Corp
NA - National Aluminate Corp
NC - National Conveyors Co
PC - The Permutit Co
PD - Prat-Daniel Corp
PE - Peabody Engineering Corp
PP - Pacific Pumps, Inc
PRP - Peerless Pump Div, Food Machinery & Chemical Corp
P&SL - Pumps & Softener Ltd
RE - Reliance Electric & Engineering Co
RF - Republic Flow Meters Co
RHE - Ross Heat Exchanger Div
SW - Sturdevant Div, Westinghouse Electric Corp
TE - Terry Steam Turbine Co
TEC - Taylor Engineering
UC - United Conveyor Co
UP - Union Steam Pump Co
US - U S Electrical Motors, Inc
WE - Westinghouse Electric Corp
WEI - Weinman Pump Mfg Co
WO - Worthington Corp
WPI - Warren Pumps, Inc
2 - 1000F reheat
4 - Also clarification process
7 - 4 pumps for 3 boilers
10 - Plus sulfuric acid feed
11 - 3 pumps for 2 boilers
15 - Number per plant
16 - 1 for 3 boilers, 1 spare
18 - H_2 & Na blended stream degasifier
19 - Feeds all boilers
20 - 4 existing pumps handle all boilers

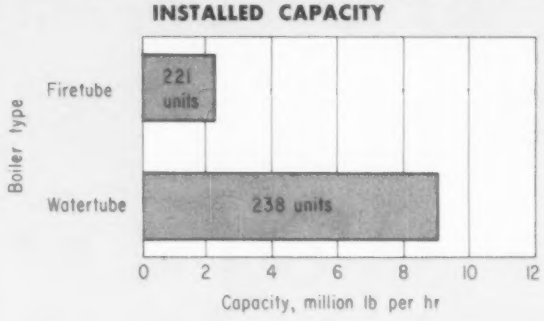


TOTAL REPORTED SALES show majority falling into lower pressure, temperature ranges. No firetube units reported provide superheat



TOTAL CAPACITY of units at saturation temperature is greatest, though many w-t boilers in this group have provision for superheat





FIRETUBE INSTALLATIONS represent 48% of total reported sales, but watertube installations supply 81% of total installed capacity

COMBINATION GAS and oil burners predominate in firing methods. Majority of oil users indicate a preference for the heavier oils

PACKAGED BOILER installations mount

- Many plants choose multiple units for capacity needs
- Oil-burning units reflect swing to residual fuels
- Number of superheater-equipped units shows increase
- Packaged boilers represent 60% of total reported sales
- They supply 44% of total boiler capacity sold

Typical packaged-boiler installations

Compiled by:
R. C. Bellas and J. W. Follansbee, Assistant Editors

Company & Location	Consulting engineers	First operation, new units	Operating pressure, psig	Operating temperature, F	Number of boilers	Capacity, each, 1000 lb per hr	Manufacturer	Boiler type	Firing equipment	Firing equipment manufacturer	Combustion control manufacturer	Draft system	Fan manufacturer	Low water cut-off and feedpump control manufacturer	Water column manufacturer	Feedwater pumps	Feedwater pump manufacturer	Feedwater treatment	Feedwater treatment manufacturer
650 TO 250 PSIG																			
Monsanto Chemical Co, Texas City, Tex		7-58	650	750	3	92	CF	WT	G		HCC	Fo	CF	HCC	DP	2-T	PP	De	BI
Chemical Construction Corp, Hammond, Ind		9-58	450	600	1	45	BW	WT	G	BW	BW	Fo	GF	MA	RG	1-M, 2-T	AM	So	ES
Amoco Chemicals Corp, Joliet, Ill	Catalytic Construction Co		425	500	2	47	CE	WT	G,O	CC	HCC	Fo	AB	RG,CV	RG	2-M	IR	So	COC
Lone Star Producing Co, Fashing, Tex	Graft Engrg Corp	7-58	375	440	3	30	VO	WT	G		MH	In	BF	MA	RG	M	IR	De	ES
Johnson & Johnson, New Brunswick, N J	Walter Kidde Constructors	12-56	318	427	2	40[1]	IBW	WT	O	TS	BM	Fo	AB	BM	EW	3-M	WS	So	GW
U S. Army Engineers, Wrightstown, N J	J. Gordon Turnbull	1958	265	400	2	12[1]	IBW	WT	O	TS	TS	Fo	AB	MA					
East Moline State Hospital, E Moline, Ill	Consoer & Townsend	1-59	250		3	38	SP	WT	O	PE		Fo				3-M, 2-T		So, Int	
Minot Air Force Base, Minot, N D	Corps of Engineers	7-58	250	400	2	25[1]	IBW	WT[2]	O,SS	TS, RS	BM	Bal	PD	MA	RG		WS	So	HM
Minot Air Force Base, Minot, N D	Corps of Engineers	7-58	250	400	2	25[1]	CE	WT[2]	O,SS,	TS, RS	BM	Bal	PD	MA	RG		WS	So	HM
N Y. International Airport, New York, N Y	Seelye, Stevenson, Value & Knecht	10-57	250	400	4	40[1]	IBW	WT[2]	G,O	TS	HC	Fo	AB	MA		2-M	WO	So	GA
Plattsburgh Air Force Base, Plattsburgh, N Y	Seelye, Stevenson, Value & Knecht	9-58	250	410	2	50[1]	CE	WT[2]	O	TS	HC	Fo	AB	MA	JG	2-M	WSP	So	HT
Quaker Oats Co, Shinemanstown, Pa		1-59	250	400	1	40	BW	WT	G,O	BW	BM	Fo	GF	BM	BW	1-M, 1-T	AC	De, Sc	AW
Truax Air Force Base, Madison, Wis		4-58	250	400	1	18.2[1]	IBW	WT[2]	O	PE	BM	Bal	CBC, PD	MA		2-M	WO	So, Int	BC
U S. Air Force Base, Mt. Home, Idaho	Corps of Engineers	11-59	250	405	1	65[1]	IBW	WT[2]	SS	RS	BM	Bal	BF	MA	EW	3-M	DC	So	PC
U S. Naval Supply Depot, Great Lakes, Ill			250	400	2	20.7[1]	IBW	WT[2]	O,SS	TS, IF	HC	Bal	IF	MA	RG	2-M	WS	So	ES
West End Chemical Co, West End, Calif		7-58	250	450	1	60	WI	WT	G,O	WI	HC	Fo	AB	MA	RG	1-M, 1-T	IR, TE	So	COC
Westover Air Force Base, Chicopee Falls, Mass	Buerkel	8-58	250	405	2	31[1]	IBW	WT[2]	O		BM	Bal	FA					So	BI
249 TO 200 PSIG																			
Warren Petroleum Corp, Madill, Okla		10-57	245	404	1	30	B	WT	G	PE		Fo		BS,B	RG	1-M, 1-T	GP, LP	So	
Warren Petroleum Corp, Madill, Okla		10-57	245	404	1	25	B	WT	G	PE		Fo		BS,B	RG	1-M, 1-T	GP, LP	So	
Mercantile National Bank Bldg, Dallas, Tex		9-58	240		1	26.7	VO	WT	G		AWC	In		CV,SC	RG	2-T	SW	So	
Texas & New Orleans RR Co, Houston, Tex	Taco Corp	10-58	240	402	2	33	CE	WT	G	CE	CE	Fo	CF	RG	RG	2-M	GP	So	PC
Tulane University, New Orleans, La	Weil & Moses	1-59	235	401	2	48	CE	WT	G,O	CE	BM	Fo	CF	RG	RG	M,T	DL	So	PC
Roddiscraft, Inc, Arcata, Calif	Ford, Bacon & Davis, Inc	1957	225	397	1	50.8	UI	WT	SS	RS	HC	Bal	AB, PD						
St. Mary's Hospital, Cincinnati, Ohio	Proctor-Ingels	7-58	225	397	2	27	VO	WT	G,O	PE	BM	Fo	CF	RG,CV	RG	1-M, 1-T	PPD	So, Int	
Atlas Powder Co, Joplin, Mo	Chemical & Industrial Corp		215	530	1	36	CE	WT	G	PE	PE	Fo	CF	RG	RG				
Cambridge Gas Co, Cambridge, Mass			215	475	2	40	CE	WT	G,O	CE	CE	Fo	CF	RG,CV	RG	1-M, 1-T	PA	So	
Ajax Steel & Forge Co, Detroit, Mich	Johnson-Larson Co		200	388	1	45	WI	WT	G,O	WI	MH	Fo	AB	CV		M,T	WO	Int	NA
International Bus. Mach., Rochester, Minn	Smith, Hinchman & Grylls	10-57	200	388	2	70	EC	WT	G,O	TS	BM	Bal	BF	SC	RG	2-M, 1-T	DL	So	PC
Kendall Co / Canada) Ltd, Toronto, Ont	Laughlin, Wylie & Ufnal	7-58	200	388	1	21	DB	WT	G,O	FR	BM, CDM	Bal	SW		DB	2-M	DV	De	PC
Metal Hydrides, Danvers, Mass		8-58	200	388	2	40	K	WT	O		PE	Fo		MH	PB	2-M, 1-T	AM	So	PC
199 TO 160 PSIG																			
Brainerd State Hospital, Brainerd, Minn	Joltz King, Duvall, Anderson & Assoc	1-60	195	386	2	55	B	WT	O	CC	BM	Fo	EL	MM	RG			So	
Indianapolis Water Co, Indianapolis, Ind		4-58	195	386	2	6.2	B	WT	O	OS		Fo				T	DBP	So, Int	
Ford Motor Co, Dearborn, Mich	J.F. Pritchard & Co	11-57	190	383	2	90	WI	WT	G,O		BM	Bal	SW						
Goodyear Tire & Rubber Co, N Bedford, Mass		3-58	190	383	1	40	WI	WT	G,O	WI	CDM	Fo	CF	MA		1-M, 2-T	UP	Int	
Sohio Petroleum Co, Lima, Ohio			185	382	1	36	VO	WT	O	PE	BM	Fo	BF	BM	RG	1-M, 1-T	IW	So	GA
General Motors Corp, Hudson, Ohio	Argonaut Realty Div	9-58	180	380	2	40	CE	WT	G,O	CC	BM	Fo	CF	RG	RG	1-M, 1-T	WD	So	GA
American Cyanamid Co, Pensacola, Fla	Lockwood Greene Engrs		175	378	3	42	CE	WT	G,O	CC	HCC	Fo	AB	RG	RG	M,T	IR	De	BI
Esso Standard Oil Co, Charleston, S.C			175	378	2	36	CE	WT	O	CE	CE	Fo	CF	RG	RG	2-T	UP	So	COC
Husky Oil & Refining, Ltd, Ft William, Ont		5-58	175	378	1	35	FWL	WT	O	PE	CDM	Fo		MA	CV	1-M, 2-T	WD		COC
Husky Oil & Refining, Ltd, Lloydminster, Sask		1958	175	378	1	35	FWL	WT	G,O	PE	CDM	Fo		MA	CV	1-M, 2-T	WD	So	
Continental Can Co, Sharonville, Ohio	A.M. Kinney	9-57	166	366	2	121	IBW	WT[2]	G,O	PE						4-M	IR	Int	HCC
Cities Service Refinery, Bronte, Ont	C.F. Braun & Co	12-58	165	366	2	50	FWL	WT	G,O	PE	RF, CDM	Fo	CBF	MA	MA	2-M, 2-T	IR	So	PS
Inland Container Corp, Franklin Park, Ill		5-58	165	366	2	12	CB	FT	G,O	CB	CDM	Fo	CB	FS	CB	2-M	PPD	So	COC
Inland Container Corp, North Lake, Ill		7-58	165		2	12	CB	FT	G,O	CB	CDM	Fo	CB	FS	CB	2-M	PPD	So	COC
Albers Milling Co, Jefferson, Wis	Thermal Engrg & Eqpt	4-58	160		1	25	K	WT	G	TS	CDM, MH	Fo	LW	MA	MA	M	AC	So	ES
159 TO 150 PSIG																			
Clark Oil & Ref. Corp, Blue Island, Ill		12-57	150	366	1	60	WI	WT	G,O	WI	BM	Fo	AB	MA,Y	WA	2-T	AS	So	AW
Columbus Hospital, Chicago, Ill	W. Grielte & Assoc	7-58	150	366	1	10	OS	FT	G,O	OS	CDM	Fo	OS	OS	OS	2-T	AM	So, Int	NA
Dow Chemical Co, Midland, Mich	Hyde & Bobbio	7-58	150	366	2	25	WI	WT	G,O	WI	HC	Fo	AB	MA,CV	RG	1-M, 2-T	IR	So	YA
Emanuel Hospital, Portland, Ore	Tom Taylor	4-58	150	366	1	10.4	OS	FT	G,O	OS	CDM	Fo	OS	OS	OS	2-M			
Fairview Canning Co, Hollister, Calif	Far Western Engrg Chemical Co		150	366	1	36	CE	WT	G,O	CE	CFE	Fo	CF	RG	RG				
Fox Realty, Lockland, Ohio	Sims & McMath	7-58	150	366	4	2.8	CB	FT	G,O	CB	CB	Fo	CB			4-M		So	DOC

Bal - Balanced draft
CG - Chain grate stoker
De - Demineralizer
Fo - Forced draft
FT - Fire tube
G - Gas
In - Induced draft
Int - Internal
M - Motor drive
O - Oil
So - Softener
SS - Spreader stoker
T - Turbine drive
WT - Water tube

1 - Million Btu per hour
2 - Lamont boiler
AB - American Blower Corp
AC - Allis-Chalmers Mfg Co
AI - Ames Iron Works, Inc
AL - Arthur S Leitch Co Ltd
AMC - Aiken-Murray Corp
AU - Aurora Pump Div, New York Air Brake Co
AW - American Water Softener Co
AWC - A W Cash Co
B - Bros, Inc
BA - Bird-Archer Co
BC - Bruner Corp
BF - Buffalo Forge Co
BG - Bell & Gossett Co
BI - Belco Industrial Equipment Div, Inc
BJ - Byron Jackson Pumps, Inc
BL - Belz Laboratories, Inc
BM - Bailey Meter Co
BS,B - Black, Sivalls & Bryson, Inc
BW - Babcock & Wilcox Co
CB - Cleaver-Brooks Co
CBC - Chicago Blower Corp
CBF - Canadian Blower & Forge Co Ltd
CC - Coen Co
CE - Combustion Engineering, Inc
CF - Clarage Fan Co
CFE - Cleveland Controls, Inc
COC - Cochrane Corp
COM - Combustion Control Div, Electronics Corp of America
CV - Copes-Vulcan Div, Blaw Knox Co
DA - Darling Bros, Ltd
DB - Dominion Bridge Co Ltd
DBP - Dean Brothers Pumps, Inc
DC - Deming Co
DCC - Dearborn Chemical Co
DHP - Dean Hill Pump Co
DL - De Laval Steam Turbine Co
DP - Diamond Power Specialty Corp
DV - Darling Valve & Mfg Co
EC - Erie City Iron Works
EL - Elliott Co
EN - Engineer Co
ES - Elgin Softener Corp
EW - Ernst Water Column & Cage Co
F - Fisher Governor Co
FA - Fly Ash Arrestor Corp
FC - Foxboro Co
FH - Francis Hanlin & Co Ltd
FM - Fairbanks, Morse & Co
FR - F. J. Rastin, Inc
FS - Fred H Schaub Engrg Co
FWL - Foster Wheeler Ltd

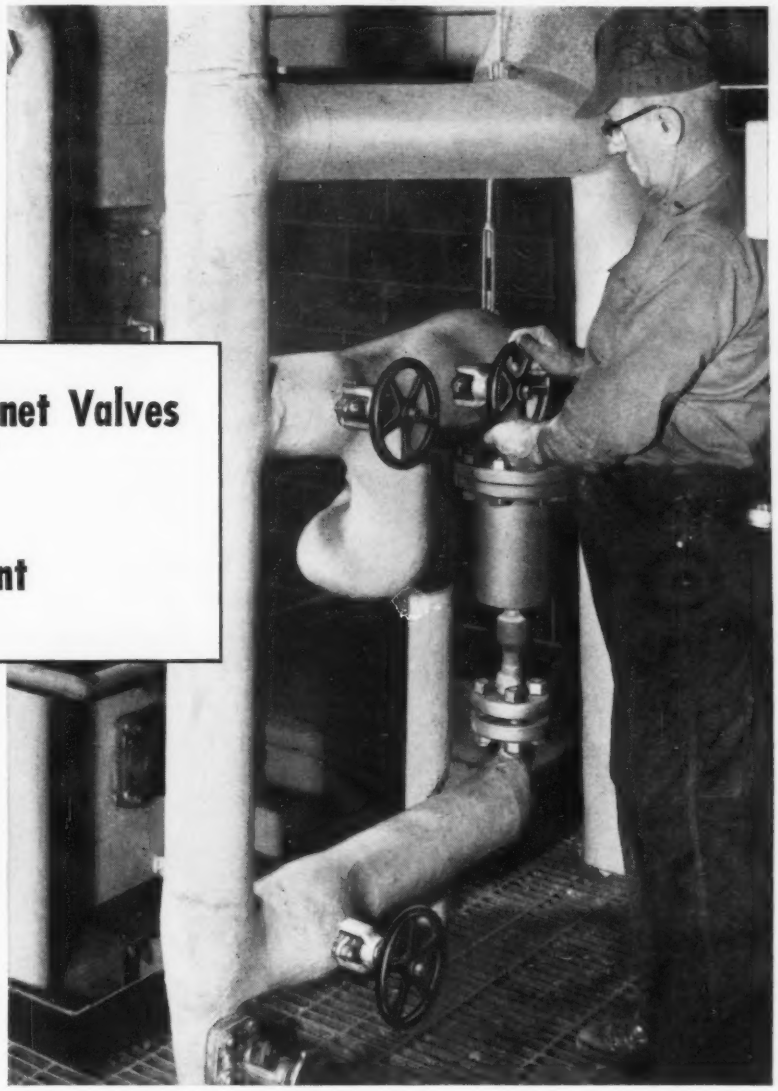
continued

Typical packaged-boiler installations

Company & Location	Consulting engineers	First operation, new units	Operating pressure, psig	Operating temperature, F	Number of boilers	Capacity, each, 1000 lb per hr	Manufacturer	Boiler type	Firing equipment	Firing equipment manufacturer	Combustion control manufacturer	Draft system	Fan manufacturer	Low water cut-off and feedpump control manufacturer	Water column manufacturer	Feedwater pumps	Feedwater pump manufacturer	Feedwater treatment	Feedwater treatment manufacturer
Gardner Machine Co, Beloit, Wis	Milwaukee Heat Transfer Div	9-58	150	366	1	3.5	YS	FT	G	MHT	COM	Fo	GF	FS	FS	4-M	BG	De,So	ES
Gardner Machine Co, Beloit, Wis	Milwaukee Heat Transfer Div	9-58	150	366	2	20	BW	WT	G	MHT	COM	Fo	GF	FS	FS	4-M	BG	De,So	ES
General Motors Corp, Allison Div, Vandalia, O		.....	150	366	1	45	CE	WT	O	CC	.....	Fo	CF	RG	RG	2-M,1-T	IR	So	GW
Goodhue Co-op Creamery, Goodhue, Minn	C.O. Bremer	.....	150	.....	1	10	AI	.....	O	.....	.....	Fo	AI	GP	AI	M	GP	Int	.....
Homestake Mining Co, Grants, N. Mex	Western Knapp Engrg Co	3-58	150	366	3	13.8	AI	FT	G,O	AI	GC	Bal	AI	AI	AI	1-M	AU	So	PC
Illinois Central R.R.Co, Louisville, Ky		.....	150	.....	2	5.2	CB	FT	G,O	CB	COM	Fo	CB	MM	MM	2-M	AU	So,Int	DCC
International Bus.Mach., Kingston, N.Y	Giffels & Valet	.....	150	366	1	40	WI	WT	O	.....	.....	Bal	AB	.....	.....	.....	.....	.....	.....
Mojonnier & Sons, Inc, Walla Walla, Wash		.....	150	366	1	10.4	OS	FT	O	OS	COM	Fo	OS	OS	OS	3-M	.....	De	SCH
Peterson Tallow Co, Emeryville, Calif	Montgomery & Davis	.....	150	366	1	30	CE	WT	G,O	CC	RIM	Fo	.....	.....	.....	2-M	.....	So	LA
Procter & Gamble Co, Cincinnati, Ohio		5-59	150	366	2	22	VO	WT	G,O	PE	PE	Fo	CF	.....	RG	1-M,1-T	GP	So	COC
St. Joseph Hospital, Chatham, Ont	Nicholas Fodor Assoc, Ltd	4-58	150	366	3	12	CB	FT	G,O	CB	MH	Fo	CB	MA	MA	2-M,1-T	DA	De	AL
St. Peters Hospital, New Brunswick, N.J		1-59	150	500	1	11	BW	WT	O	TS	BW	Fo	.....	.....	RG	3-T	.....	Int	BL
Standard Oil Co of Calif, Richmond Bch, Calif		1-58	150	366	1	40	CE	WT	O	CE	CE	Fo	CF	RG	RG	1-M,1-T	BF,WO	So	DCC
Toledo Hospital, Toledo, Ohio	Ellerbe & Co	.....	150	366	2	40	K	WT	G,O	PE	RF	Fo	CF	SC	RG	1-M,1-T	DHP	So	PC
Trojan Hardware Co, Green Island, N.Y	L. Rosetti	.....	150	366	1	17.3	OS	FT	O	OS	COM	Fo	OS	OS	OS	1-M	IR	Int	.....
Vickers Petroleum Co, Potwin, Kans	Procor	6-58	150	366	2	30	VO	WT	G,O	PE	PE	Fo	.....	RG	RG	2-M	AC	So	GW
149 TO 125 PS.IG																			
Allen Mfg Co, Bloomfield, Conn		8-58	125	353	2	24	CE	WT	G,O	CE	CFE	Fo	CF	RG	RG	1-M,1-T	WO	Int	BL
American Airlines, Tulsa, Okla	Coston & Frankfort	9-58	125	.....	3	25	B	WT	G	WEB	WEB	Fo	.....	F	F	1-M,1-T	GP	So	IN
Belcraft Laundry, Dalton, Ga	Bob Johnston Co	8-58	125	353	1	30	CE	WT	G,O	PE	PE	Fo	.....	CV	RG	1-M,1-T	BF	Int	.....
Blakeley Laundry, Trenton, N.J	George London	7-58	125	353	1	20.6	K	WT	O	IH	AWC	Bal	ST	MA	RG	2-T	IR,WO	So,Int	NM,PC
Dundee Co-op Creamery, Ltd, New Dundee, Ont		5-58	125	353	1	21	FWL	WT	O	PE	PE	Fo	.....	CY	.....	2-M	STM	So,Int	FH
Empire Laundry, Baltimore, Md	Power & Combustion	1-58	125	.....	1	17.3	AI	FT	O	AI	COM,MH	Fo	.....	MM	.....	2-M	FS	So	
Ford Motor Co, Rawsonville, Mich	J.F. Pritchard & Co	11-56	125	353	3	40	UI	WT	G,O	.....	MH	Fo	SW	.....	.....	M,T	BF	So	PC
R T French Co, Shelly, Idaho	Henry Peck Assoc	9-57	125	.....	1	17.3	CB	FT	G,O	CB	.....	Fo	.....	MA	MA	2-M	.....	So	LA
R T French Co, Shelly, Idaho	Henry Peck Assoc	9-58	125	.....	1	22	K	WT	G	PE	COM	Fo	.....	.....	.....	1-M	FM	So	LA
WA Gilbey I Canada Ltd, New Toronto, Ont		.....	125	353	1	30	FWL	WT	O,G	PE	PE,MH COM	In	.....	MH	MA	2-M,1-T	AL,GJW	So	AL
Hot Springs Co., Mem. Hospital, Thermopolis, Wy		1-59	125	353	3	5.7	UI	WT	G,O	.....	.....	Fo	.....	MM	.....	.....	.....	So	PC
New Jersey State Prison, Trenton, N.J	Grady & Meyer	5-58	125	353	1	40	SCI	WT	O	.....	HC,COM	.....	.....	RG	RG	M,T	UP,PP	So	PC
Orange County Gen. Hospital, Orange, Calif	A.M. Hagler	.....	125	353	1	20	BW	WT	G,O	BW	BM	Fo	GF	BM	RG	M	DL	So	.....
Texas Co, Beason, N.Y		10-58	125	353	1	36	CE	WT	O	CC	HCC	Fo	AB	RG,CV	RG	2-T	IR,DBP	Int	HCC
U.S. Navy, Whiting Field, Milton, Fla		.....	125	353	1	27.5	CE	WT	G,O	CE	.....	.....	.....	.....	.....	.....	.....	.....	.....
124 TO 101 PS.IG																			
Alexian Brothers Hospital, St. Louis, Mo	H. Wilson & Assoc	.....	115	347	1	18	CE	WT	G,O	CC	CC	Fo	AB	RG	RG	2-T	UP	So,Int	PC
A.F. Murch Co, Paw Paw, Mich		9-57	115	347	1	26.7	CB	FT	G	CB	CB	Fo	CB	MA	MA	1-M	FS	Int	.....
Bx..rfoot Sole Co, Wadsworth, Ohio	Urban, Klug & Pittenger	3-58	110	.....	1	30	BW	WT	G	BW	BM	Fo	GF	RG	RG	1-M,1-T	PA	So	PC
100 PS.IG																			
Bellin Memorial Hospital, Green Bay, Wis	John Myers	.....	100	338	1	10	CE	WT	G,O	PE	PE	Fo	CF	RG	RG	2-M	FS	So	DCC
Boeing Airplane Co, Moses Lake, Wash	Bullion & Griffeth	5-58	100	338	2	45	CE	WT	O	EN	RF	Fo	.....	CV	CV	2-M,1-T	.....	De,So	FM
Devoe & Raynolds Co, Louisville, Ky	E.R.Ronald & Assoc	1-58	100	.....	1	20	VO	WT	G,O	PE	.....	Fo	CF	RG	RG	1-M	AU	.....	.....
Federal Cartridge Corp, Anoka, Minn		7-58	100	338	2	40	B	WT	O	PE	CV	In	CF	CV	LU	T	DHP	So	.....
Good Samaritan Hospital, Dayton, Ohio	C.J. Lahman	1960	100	338	3	16	BW	WT	G,O	BW	CV	Fo	GF	BM	RG	1-M,1-T	IR	So,Int	COC,BA
Good Samaritan Hospital, Lebanon, Pa	George Ewing	9-57	100	338	3	3.5	CB	FT	G,O	CB	COM	Fo	CB	MA	MA	3-M	.....	So	PC
Harbison-Walker Refrac.Co, Hammond, Ind		10-57	100	338	1	21	CE	WT	G,O	CE	CE	Fo	CF	CV	RG	2-M	BJ	Int	BL
Linde Div, Union Carbide Corp, Newark, N.J		1-58	100	338	1	13.8	AI	FT	O	AI	COM	Fo	AI	.....	AI	1-M	.....	So	.....
Perini-McNamara-Quemont, Chute des Passes Power Project, Isle Maligne, Quebec, Canada	Preston, Phipps, Inc	.....	100	450	4	4.3	VL	FT	O	MW	COM	Fo	VL	AU	MM	1-M	NY	.....	.....
	Preston, Phipps, Inc	.....	100	450	1	5.2	VL	FT	O	MW	COM	Fo	VL	AU	MM	1-M	NY	.....	.....
	Preston, Phipps, Inc	.....	100	450	3	8.6	VL	FT	O	MW	COM	Fo	VL	AU	MM	1-M	NY	.....	.....
	Preston, Phipps, Inc	.....	100	450	3	10.4	VL	FT	O	MW	COM	Fo	VL	AU	MM	1-M	NY	.....	.....
Sterling-Winthrop Re.Lab, Rennssalaer, N.Y		.....	100	350	1	20	K	WT	O	PE	HCC	Bal	LJW	.....	RG	1-T	AM	Int	HCC
Union Carbide Nuclear Co, Maybell, Colo	Southwestern Engrg. Co	10-57	.....	325	2	12[1]	IBW	WT[2]	O	TS	FC	In	SW	.....	.....	2-M	DBP	So	PC
Haynes-Stellite Co, Kokomo, Ind	Barnes Engrg Co	12-57	.....	.....	1	27	K	WT	C,G	LS	CV	Bal	WE,PD	CV	PH	1-M	PPD	So,Int	ES
Bishop & Co, Malvern, Pa		12-58	.....	.....	1	15[1]	CE	WT[2]	O	CC	CC	Fo	CC	.....	.....	2-M	.....	So	.....
U.S. Naval Air Station, Columbus, Ohio	Beiswenger & Hoch	10-57	.....	.....	2	15[1]	IBW	WT[2]	G	PE	.....	Fo	CF	MM	.....	2-M	AM	Int	.....

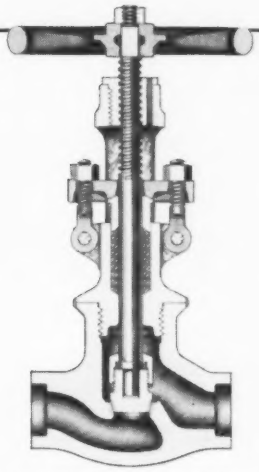
GC - General Controls Co
GF - Green Fuel Economizer Co, Inc
GJW - G & J Weir, Ltd
GP - Goulds Pumps, Inc
GW - Graver Water Conditioning Co
HC - Hays Corp
HCC - Hagan Chemicals & Controls, Inc
HM - H M Mueller Corp
HT - Hungerford & Terry, Inc
IBW - International Boiler Works
IF - Iron Fireman Mfg Co
IH - Indiana Heat & Power Co
IN - Infilco, Inc
IR - Ingersoll-Rand Co
IW - Illinois Water Treatment Co
JG - Jorgusen Gage & Valve Co
K - E Keeler Co
LA - L-A Water Softener Co
LJW - L J Wing Mfg Co
LS - Laclede Stoker Co
LU - Lunkenheimer Co
MA - Magnetrol, Inc
MH - Minneapolis-Honeywell Regulator Co
MHT - Milwaukee Heat Transfer Div
MM - McDonnell & Miller, Inc
MW - Monarch Mfg Works, Inc
NA - National Aluminate Corp
NM - North American Moqul Products Co
OS - Orr & Sembower, Inc
PA - Pennsylvania Pump & Compressor Co
PB - Penberthy Mfg Co, Div of the Buffalo Eclipse Corp
PC - The Permutit Co
PD - Prat-Daniel Corp
PE - Peabody Engineering Corp
PH - Paul B. Huyette Co, Inc
PP - Pacific Pumps, Inc
PPD - Peerless Pump Div, Food Machinery & Chemical Corp
PS - Pumps & Softeners Ltd
RF - Republic Flow Meters Co
RG - Reliance Gauge Column Co
RIM - Reliance Instrument Mfg Co
RS - Riley Stoker Corp
SC - Swartwout Co
SCH - Strong, Carlisle & Hammond Co, Inc
SCI - Superior Combustion Industries Inc
SP - Springfield Boiler Co
ST - Spencer Turbine Co
STM - Smart-Turner Machine Co Ltd
SW - Sturtevant Div, Westinghouse Electric Corp
TE - Terry Steam Turbine Co
TS - Todd Shipyards Corp, Prod Div
UI - Union Iron Works
UP - Union Steam Pump Co
VL - Volcano Ltd
VO - Henry Vogt Machine Co
WA - Wright-Austin Co
WEB - Webster Engineering Co
WI - Wickes Boiler Co
WO - Worthington Corp
WS - Wilson-Snyder Works, United States Steel Corp
WSP - Wagner Steam Pump Co
YS - York-Shipley Inc

Newest Design in Small Steel Globe, Angle and Check Valves



Crane Lip Seal Bonnet Valves
(patented)

Save Money for This Power Plant



Central Illinois Electric & Gas Co.'s experience with Lip-Seal valves is typical. Since 1952, this patented Crane small steel valve design for high-pressure/high-temperature service has saved this utility many dollars.

Shown is a 3-valve installation at Sabrooke Station in Rockford on 900 psi steam lines to the ash removal system. In more than 5 years on this tough service, none was given more than minimum routine maintenance—never any attention to bonnet joints.

On other severe services as well, the plant is aware of the continuous good performance and easy care of Lip-Seal valves. More are being installed as other makes give out.

Lip-Seal design features a strong, non-freezing screwed bonnet joint that holds pressure load, with a peripheral weld for tightness only. Weld grinds off easily and repeatedly without damaging joint.

Improved disc-stem connection minimizes vibration . . . provides pilot guiding for the disc. Stellite seating surfaces withstand temperature, corrosion and erosion. Globe, angle and check patterns; 1500- and 2500-pound classes. Sizes ½ to 2 inches. Get full information from your Crane Representative.

Literature on Lip-Seal valves supplied by your Crane Man, or write to address below.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill., Branches and Wholesalers Serving All Areas

In Canada: Crane, Limited, 1170 Beaver Hall Square, Montreal, Que.

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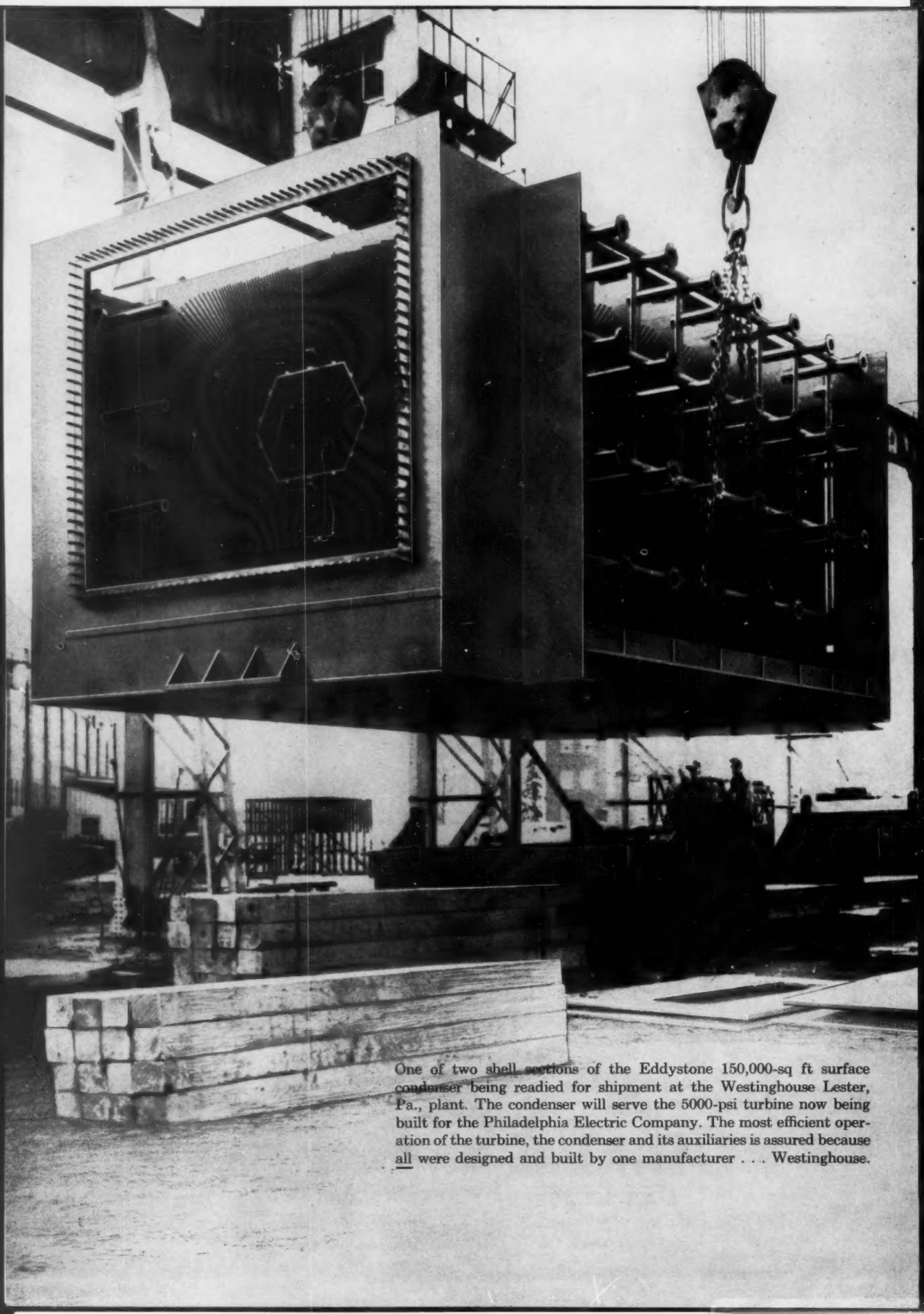


One of two shell sections of the Eddystone 150,000-sq ft surface condenser being readied for shipment at the Westinghouse Lester, Pa., plant. The condenser will serve the 5000-psi turbine now being built for the Philadelphia Electric Company. The most efficient operation of the turbine, the condenser and its auxiliaries is assured because all were designed and built by one manufacturer . . . Westinghouse.

New Westinghouse Condenser will help Eddystone 5000-PSI Turbine set world's efficiency record

ANOTHER GIANT STEP has been taken towards the completion of Philadelphia Electric Company's Eddystone station.

Westinghouse has shipped the 150,000-sq ft surface condenser to serve the world's most efficient turbine. Now being built by Westinghouse, the Eddystone turbine will use the highest temperature and pressure steam ever projected...5000 psi at 1200°F.

New Condenser

Because the Eddystone station will use a once-through steam generator, Westinghouse and Philadelphia Electric engineers jointly developed several new features for this surface condenser. *Both of these Westinghouse "firsts" were announced to the industry during the early design stages.*

The detection and location of even *small* leaks are made possible by twenty sampling compartments in the condenser's upper hotwell and collecting trays below the tube sheets. The lower hotwell is divided into three sections, and if any one becomes contaminated, the condensate can be by-passed into a water tank.

Through the second feature, during start-up or in the event of a trip-out or emergency, steam must be diverted from the turbine to the condenser. To protect the condenser from high-pressure and high-temperature steam, this steam is passed through four condenser injection coolers, which act as desuperheaters and pressure reducers.

Fifty Years of "Design Firsts"... Through Plowback of Earnings into Research

The installation of this Westinghouse condenser marks the 50th anniversary of Westinghouse research in designing and building surface condensers. During the past 50 years, Westinghouse has developed many of the *basic* condenser designs that today help the industry to produce low-cost electricity. Westinghouse "design firsts" include radial-flow, air ejectors, steel diaphragms for tube expansion, vertical propeller pumps and reverse flow valves.

Because of its vast and continuing research projects, Westinghouse has been traditionally *first* with design improvements. That's why it pays to specify Westinghouse. *You get today... the surface condenser of tomorrow.*

For complete information, contact your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-50608

Research developments now underway

Through Plowback of Earnings into research, Westinghouse is pioneering many condenser developments that will do much to help the industry meet future loads with low-cost electricity. Following are a few of the projects that are underway in the $6,000,000 Westinghouse Steam Development Laboratory.

Lower costs for foundations

Westinghouse research and development engineers are exploring new structural designs that promise to slash the weight and size of surface condensers and result in lower costs for foundations.

Dropwise condensation for improved heat transfer

If tube surface were nonwettable, steam would condense as droplets, rather than as a heat-barrier film. Westinghouse is searching for the water repellent that will keep the tubes nonwettable *throughout the life of the condenser*. This research project will result in improved heat transfer rates . . . and permit a great reduction in the size, weight and cost of condensers.

Reduction of aerodynamic losses

Westinghouse engineers are probing all the interrelated causes of aerodynamic losses in the transition section between the turbine and the condenser. These studies, made in cooperation with the turbine department, are leading to design changes that will give the industry condensers that are not only smaller, but more efficient.

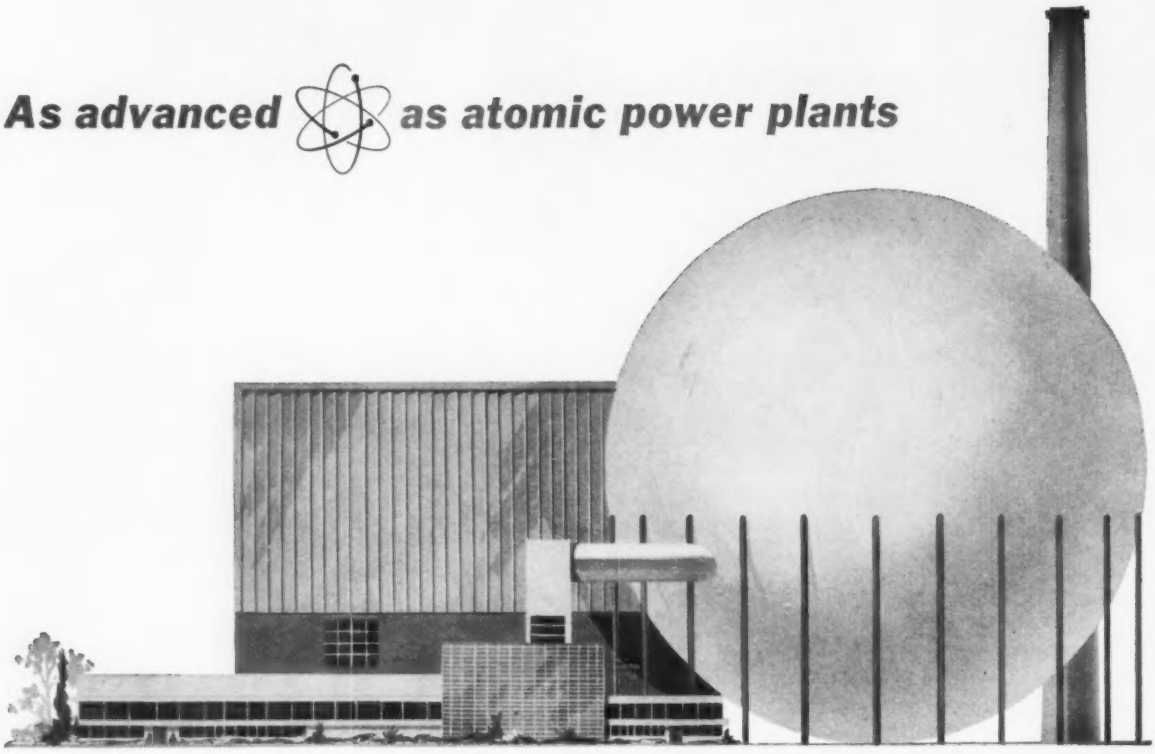
Greater velocity for increased efficiency

The greater the water velocity, the better the heat transfer rate. Also true — the greater the velocity, the shorter the life of the tubes. In the Westinghouse Steam Development Laboratory, engineers are busy studying ways to prolong the life of tubes subjected to water velocities greater than the present seven to eight feet per second.

YOU CAN BE SURE...IF IT'S **Westinghouse**

For more facts circle 817 on Reader Service Card p 222

As advanced as atomic power plants



INFILCO ION EXCHANGERS

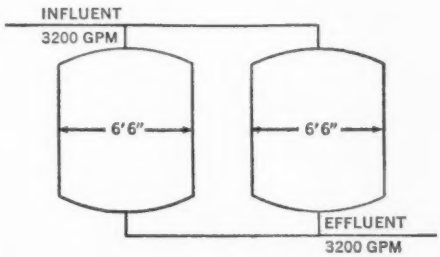
treat boiling water reactor condensate at

50 GPM PER SQUARE FOOT

Two 6'-6" diameter mixed bed demineralizers with a total surface area of 64 sq. ft. are now being installed to handle 3,200 gpm of reactor condensate. These units will produce polished condensate with a conductivity of approximately 0.1 micromho in a fraction of the space and at much lower installation cost than conventional equipment.

The plant design is based upon extensive pilot plant studies using a 24" diameter unit to treat unfiltered condensate at 200 gpm (68 gpm per sq. ft.). The equipment and techniques developed for this plant are also applicable to high pressure conventional and super-critical pressure plants.

Results of pilot plant studies and design features of this ultra-modern installation will be sent free upon request. Write today for Reprint #88.



Infilco Inc., General Offices: Tucson, Arizona, P.O. Box 5033
Field Offices throughout the United States and in foreign countries.

INFILCO

THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment. 68501

The Allen-Sherman-Hoff Company was incorporated in 1921 by three outstanding leaders in the ash handling field, Messrs. F. B. Allen, M. C. Sherman and L. P. Hoff. The stated purpose of the new company was the manufacture of ash hoppers, but from the start they pioneered in the development of complete hydraulic and pneumatic materials handling systems for the removal of ash, slag, dust and other industrial solids.

As the demand for ash and dust handling systems increased, The Allen-Sherman-Hoff Company expanded to keep pace. Today their facilities are the largest and most complete in the industry. Competent field engineers are strategically located in 19 cities in the U.S. and 3 in Canada. Service engineers are permanently assigned to most of these offices.

It was a happy coincidence that the initials of our founders' last names spelled the word ASH. This appropriate combination of letters soon became our trademark—and the watchword wherever ash handling needs arise.

During our 36 years of growth we have averaged better than 60 major contracts per year. The knowledge and experience we have accumulated are available to help solve your problem, no matter how big or how small. Describe your problem and we'll rush you helpful data or arrange for a competent field engineer to call.

* *A-S-H service doesn't stop with installation. When service problems come up, we stand ready to give prompt service assistance. This is a policy worth considering when suppliers are being selected.*

MATERIALS HANDLING SYSTEMS

"Hydrojet" *hydraulic*

"Hydrovac" *pneumatic*

A-S-H

the **Allen-Sherman-Hoff** company

259 E. Lancaster Ave., Wynnewood, Pa.

Offices and representatives in principal cities

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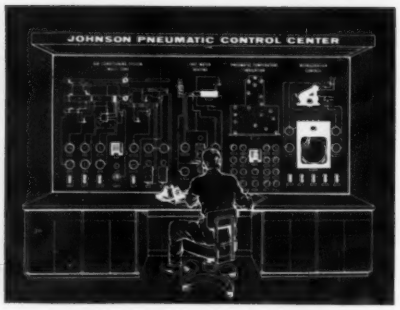


PNEUMATIC TRANSMISSION

Pneumatics simplifies and improves centralized control of Air Conditioning—makes Control Centers easier to understand and operate

With pneumatic transmission by Johnson you get the benefits of control center instrumentation that is as simple and trouble-free as the pneumatic controls used elsewhere in the building!

Thanks to universal familiarity with pneumatic controls, operating personnel easily become expert in the operation of even the largest pneumatic control centers. No highly specialized training or extensive study is required.

Since pneumatic transmission functions with both fewer and simpler components, there are no complex, costly upkeep problems.

CONTINUOUS INDICATION

Pneumatic transmission offers other exclusive advantages that add greatly to ease of operation and efficiency of centralized control.

For example, only the pneumatic control center gives the operator *continuous* indication of key temperatures. With a separate pneumatic thermometer for each key point, he can check the entire system with a single glance. There are no buttons to push, no waiting for periodic logging, no codes to check.

NO SIDE EFFECTS

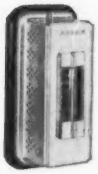
Likewise exclusive are control pressure gages that allow the operator to observe the operation and position of controlled devices at remote points. And, of course, only pneumatic systems are immune to the effects of humidities, temperatures, transient electrical currents, voltage fluctuations and other outside variables. This assures the extreme accuracy necessary for continuous, precision control.

CHOICE OF FEATURES

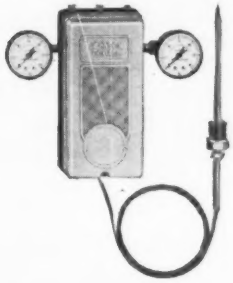
The use of pneumatic transmission for the centralized control of air conditioning and heating systems allows complete flexibility in the choice of control features. The Johnson line includes a wide selection of remote indicating, recording and controlling instruments, some of which are shown on the opposite page.

Pneumatic transmission as applied by Johnson offers you the same exclusive combination of accuracy, simplicity and superior performance that have long made pneumatic temperature control systems the standard everywhere. A nearby Johnson engineer will gladly give you more facts about these and other advantages of pneumatic control centers.

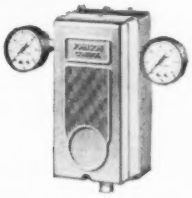
Johnson offers you Control Center instrumentation to meet the exact requirements of the individual installation



T-1210 Room Transmitter. Transmits space temperature to Control Center. Has highly sensitive, low-mass bi-metal measuring element. Temperature range is 50 F.



T-1220 Transmitter. Measures temperature in ducts, pipes, tanks, and other remote locations. Compensated, liquid filled measuring element. Ranges of 100 and 200 F available.



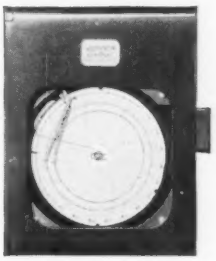
T-1270 Receiver Controller. Receives measurements from transmitter and either (1) controls directly, (2) resets remote submaster controllers or (3) acts as a remotely reset submaster to control as in (1) or (2).

T-1250 Pneumatic Thermometer. For remote indication of temperature as measured by transmitter. Available in a wide variety of sizes and ranges, with Fahrenheit or Centigrade scales.

G-201 Control Pressure Gage. Provides continuous remote indication of the operation of the controllers and position of controlled devices. An invaluable aid to operation.

S-222 Pneumatic Gradual Switch. Permits manual readjustment of the set point of remotely located instruments from the Control Center. Small, highly accurate, trouble-free.

Pneumatic Push-Button Switch. May be used to start and stop fans, pumps and other electrical devices or to position any control device or equipment requiring two-position manual switching.



T-1000 Recorder-Controller. Furnished with powerful, high-accuracy measuring elements for temperature, pressure or relative humidity control applications. One-pen and two-pen models available.

Target Gage. Used in conjuction with Pneumatic Push-Button Switches to indicate operation of electrical equipment. Equipped with high visibility red or green fluorescent segments.

Miniature Indicating Controller. Conserves space on panels without sacrificing quality of control. A wide variety of easy to read scales and charts are available.

Miniature Recorder-Controller. Plug-in type, completely interchangeable with Miniature Indicating Controllers. For temperature or pressure control applications.

T-1050 Indicating Controller. For temperature, pressure or relative humidity applications not requiring a chart record. Master and submaster models available.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

JOHNSON SERVICE COMPANY
Milwaukee 1, Wisconsin

Please send Johnson Control Center Booklet S-103

Name & Title_____

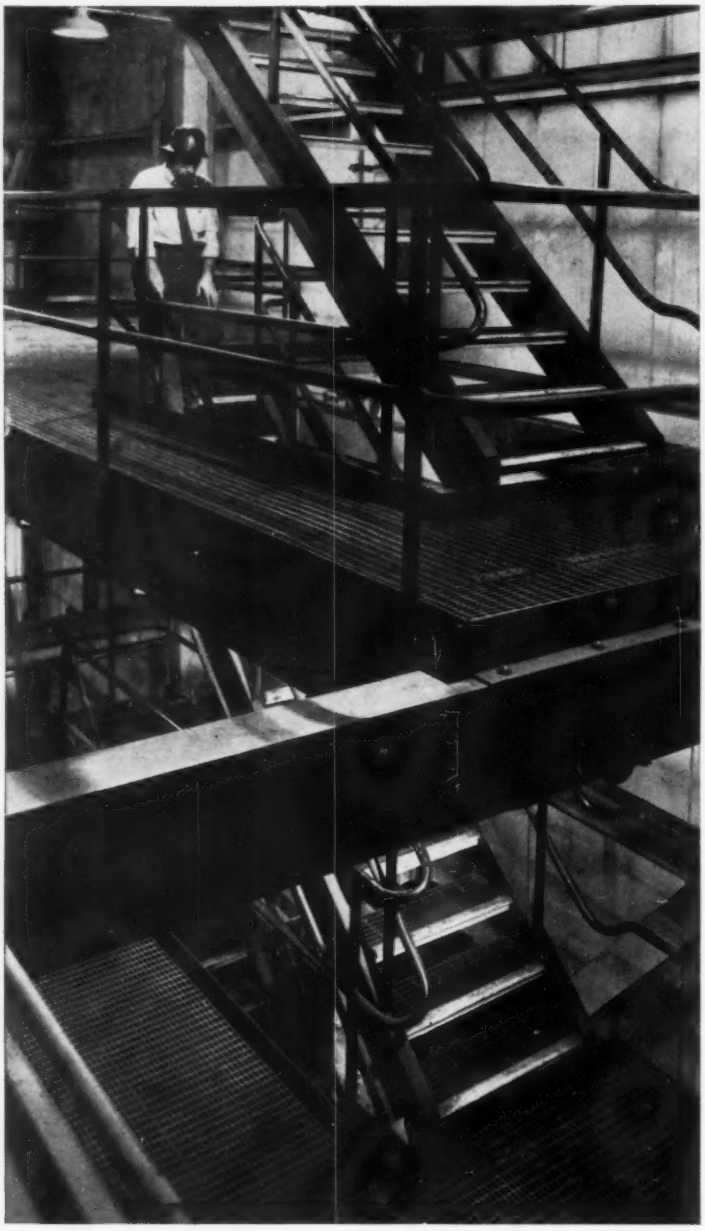
Firm_____

Address_____

City & State_____

For more facts circle 820 on Reader Service Card p 222

Where a misstep costs $500... Blaw-Knox Electroforged® Steel Grating provides safer non-slip footing



Stair falls cost industry over $60,000,000 a year.

An average accident amounts to a loss of $500 in claims.*

A good way to guard against these profit-eating accidents is to construct your stair treads, walkways and floors with Blaw-Knox Electroforged Steel Grating. Non-slip twisted crossbars and a wide variety of bearing bars are available to meet every kind of working condition—safely solving the most hazardous skid situations.

Rigid, one-piece construction makes installation easy. Once on the job, Blaw-Knox grating practically takes care of itself. There is nothing to wear, nothing to patch, no dirt collecting corners to clean. It goes anywhere, fitting neatly around pipes, beams and machinery, admitting plenty of light and air to the area.

Made to your specifications, Blaw-Knox grating provides new highs in safety, easy up-keep and flexible application. For new ideas about grating—including space saving platforms and shelving, write for Bulletin 2486.

*Based on a study analyzing 803 compensable work injury claims closed in Illinois involving stairs and steps.

BLAW-KNOX

BLAW-KNOX COMPANY

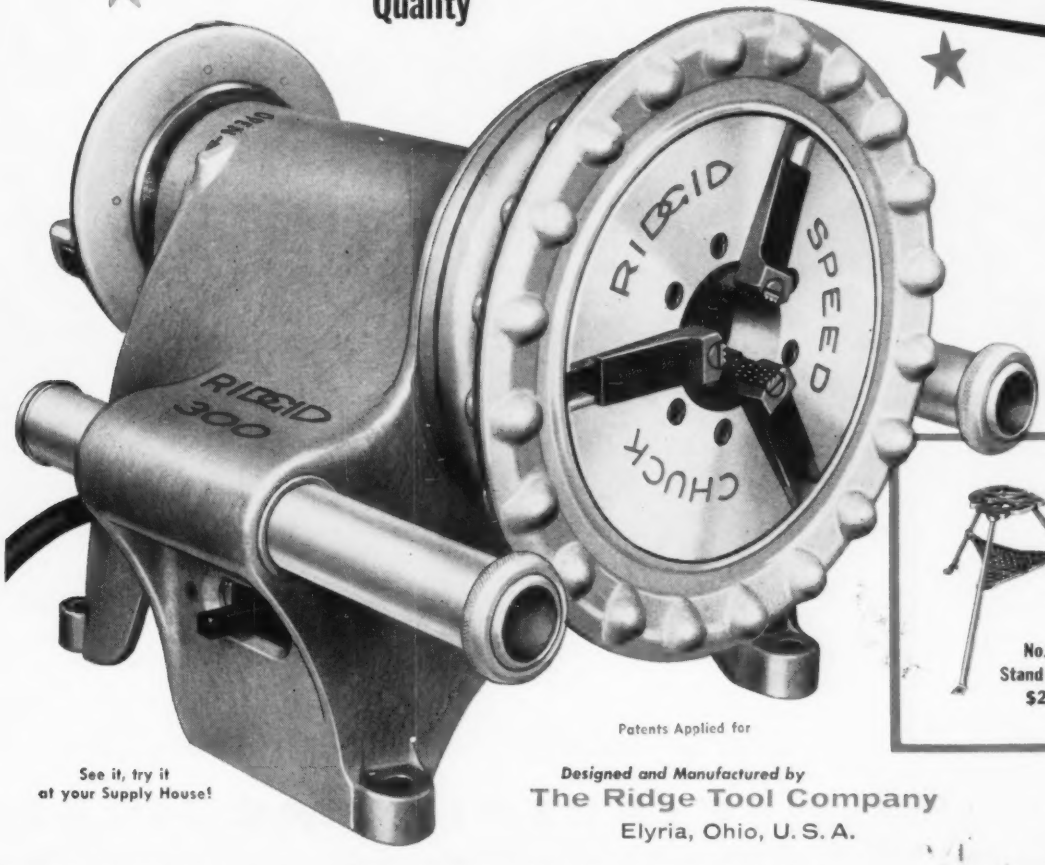
Equipment Division
Dept. K, Pittsburgh 38, Pennsylvania

For more facts circle 821 on Reader Service Card p 222

Introducing... the ALL NEW RIDGID 300 Power Drive

- Full 1/8" to 2" capacity
- Light-Weight • Heavy-Duty
- Unmatched RIDGID Quality

$199.50



No. 1206
Stand Available
$27.00

Patents Applied for

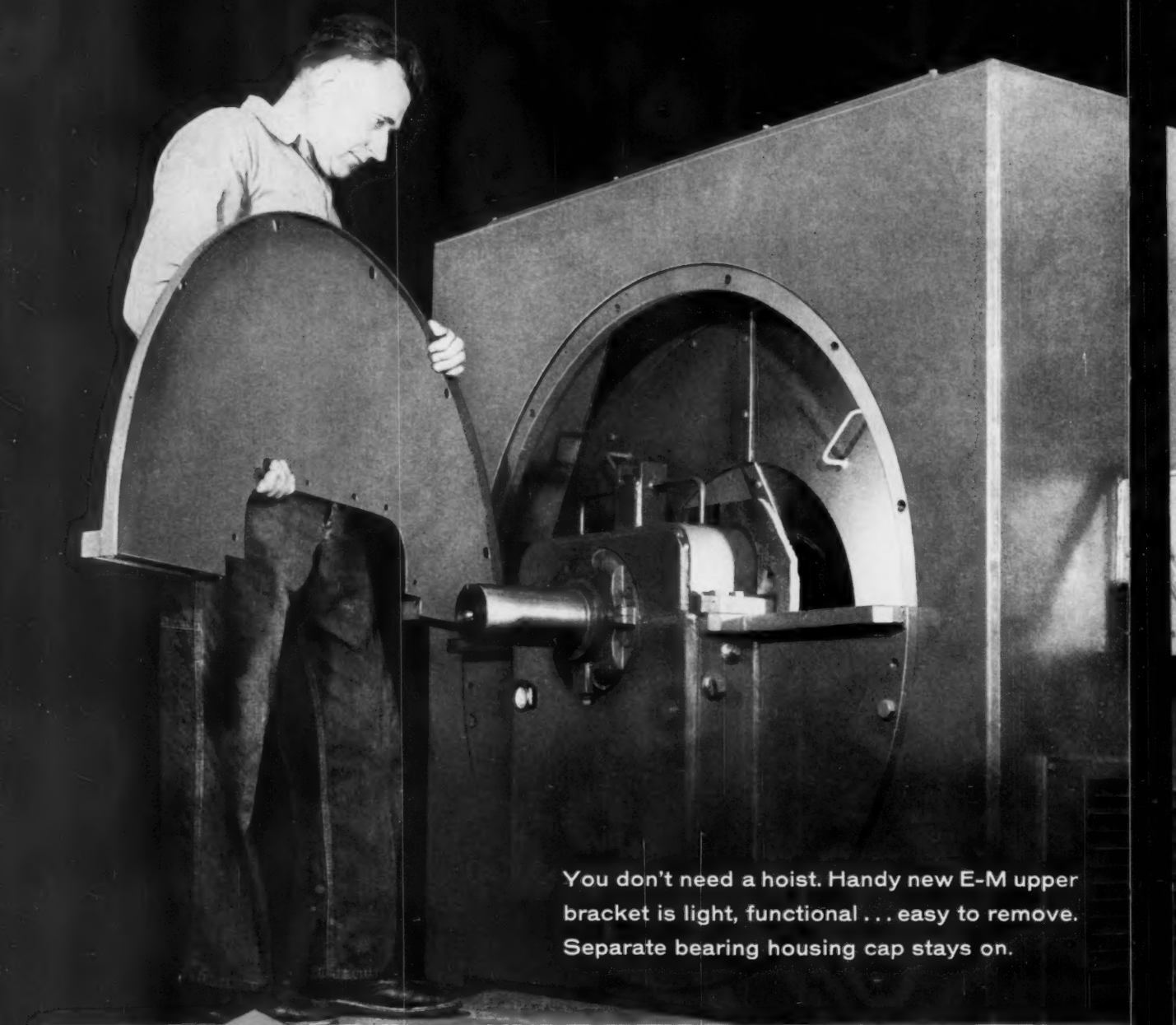
See it, try it
at your Supply House!

Designed and Manufactured by
The Ridge Tool Company
Elyria, Ohio, U. S. A.

For more facts circle 822 on Reader Service Card p 222

NOW Save costly man-hours, reduce downtime with the new E-M Straight-Up-Ventilated Boiler Feed Pump Motor. It gives you . . .

Quick and Easy Access



You don't need a hoist. Handy new E-M upper bracket is light, functional . . . easy to remove. Separate bearing housing cap stays on.

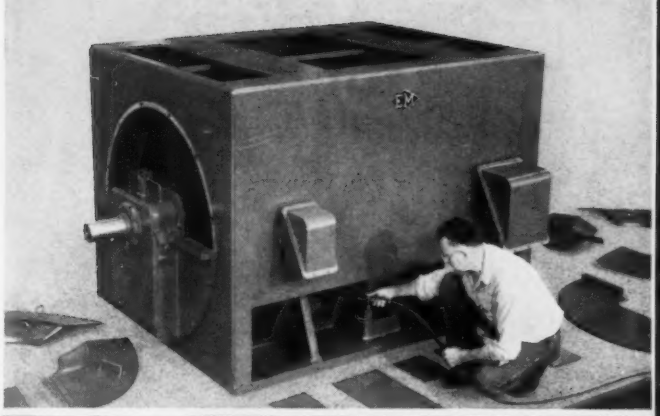
E-M

1300-TPA-2158

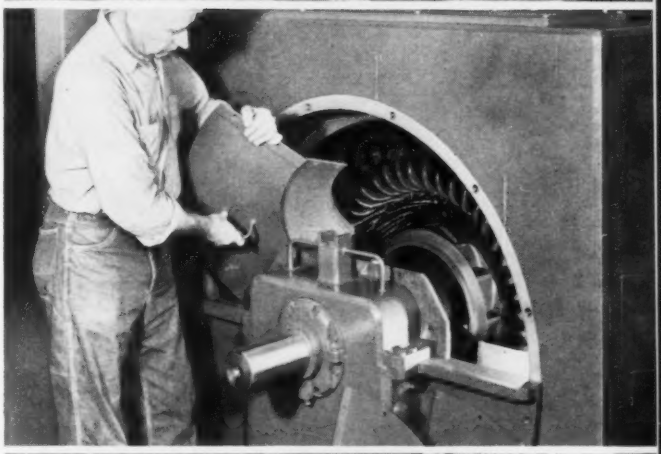
ELECTRIC MACHINERY

Builders of the new pump motor

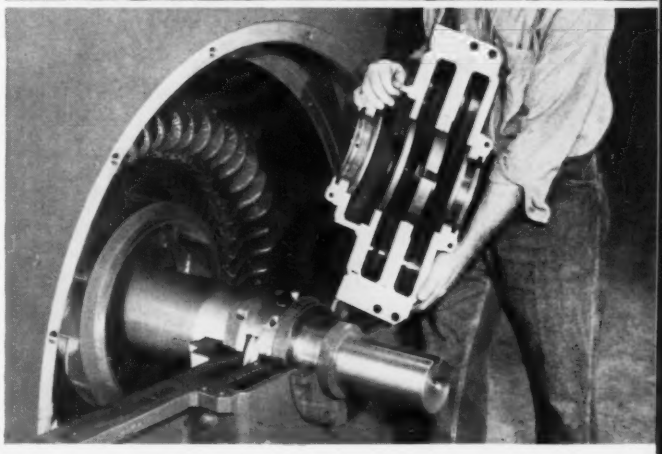
It's easy to remove louvers —just unbolt, lift off. Access plates let you clean thoroughly behind stator core.



Coils are readily checked for condition and cleanliness. Four-section air baffle comes out easily without taking off lower bearing bracket.

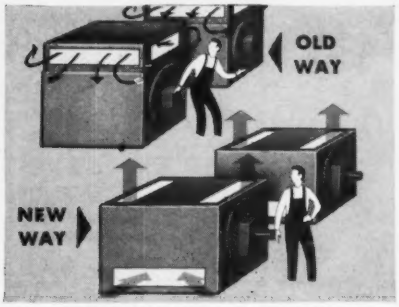


Just lift the cap to inspect bearings. Raise the rotor shaft to roll out the lower bearing half.

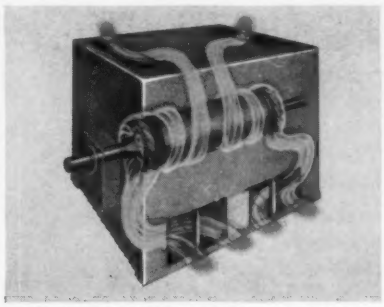


Learn more about the motor that's a pleasure to service. Ask your nearby E-M Sales Engineer and write to the factory for your copy of illustrated brochure No. 1134-P.

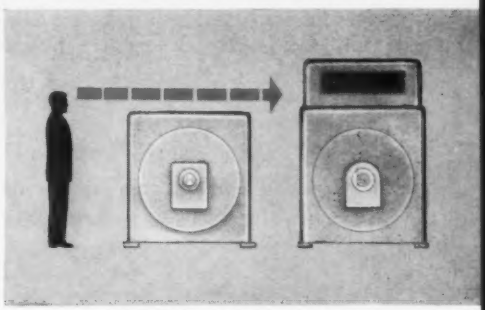
More of the MANY BIG DIFFERENCES that MAKE THE DIFFERENCE



STRAIGHT-UP-VENTILATION



AIR-FLOW ACOUSTICAL CONTROL



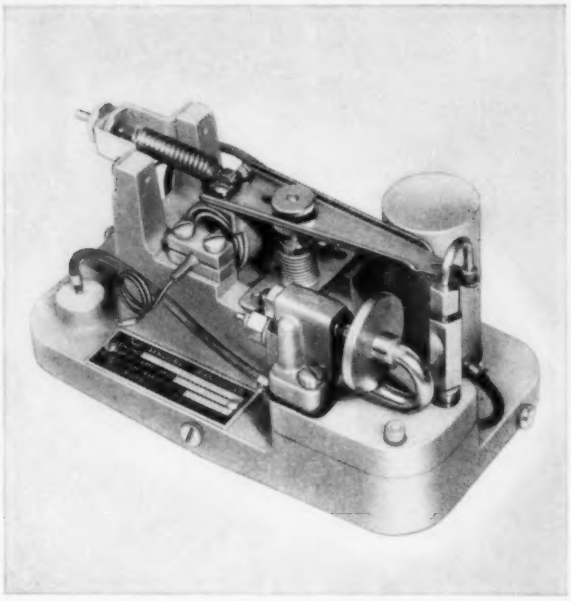
MINIMUM HEIGHT—MAXIMUM VISIBILITY

MFG. COMPANY MINNEAPOLIS 13, MINNESOTA

that performs as well on the job as on the test stand

For more facts circle 823 on Reader Service Card p 222

LOW COST AND EASE OF INSTALLATION PERMIT WIDE USAGE.



OPERATIONAL SIMPLICITY IN A RUGGED, COMPACT UNIT.

TAYLOR ANNOUNCES NEW LOW-COST TEMPERATURE TRANSMISSION

New SENSAIRE* Transmitter: rugged, compact, force-balance, with mercury-filled system. Self-compensating for ambient temperatures.

The new Taylor SENSAIRE temperature transmitter now makes more widely available low cost temperature measurement within limits of minus 30°F. to plus 1200°F., with simplified adjustments and excellent repeatability. Available in range spans of 50°F., 100°F., 200°F., and 400°F.

Individual transmitters are factory calibrated in one of four available range spans. A simple thumb-screw adjustment zero-sets the instrument within wide limits. This adjustment is accomplished with high accuracy, and no further calibration is necessary. Factory calibrated accuracy is well within 1% of rated range, below 550°F; 1½ % above 550°F.

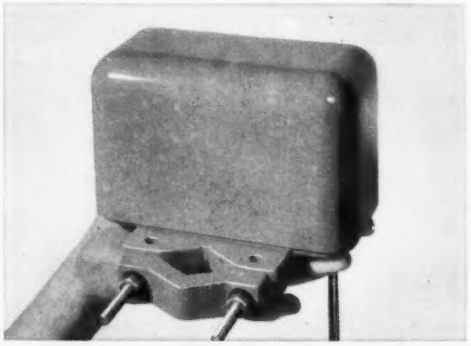
All SENSAIRE transmitters and components are interchangeable (regardless of range). A measuring system encompassing a new range span or new range limits (other than those obtainable with zero adjustment) may be added in the field.

Write for SENSAIRE **Bulletin 98293,** Taylor Instrument Companies, Rochester 1, N. Y., or Toronto, Ontario.

*Trade Mark

Taylor Instruments
MEAN ACCURACY FIRST

Unusually Fast Response. Due in part to its extremely small bulb, the SENSAIRE transmitter has an unusually fast speed of response. However, for processes that require it, the SPEED-ACT* (derivative response adjustment) unit is available. The SPEED-ACT feature is of special value where the bulb is placed in a well, or in processes using material with poor thermal transmission rates.



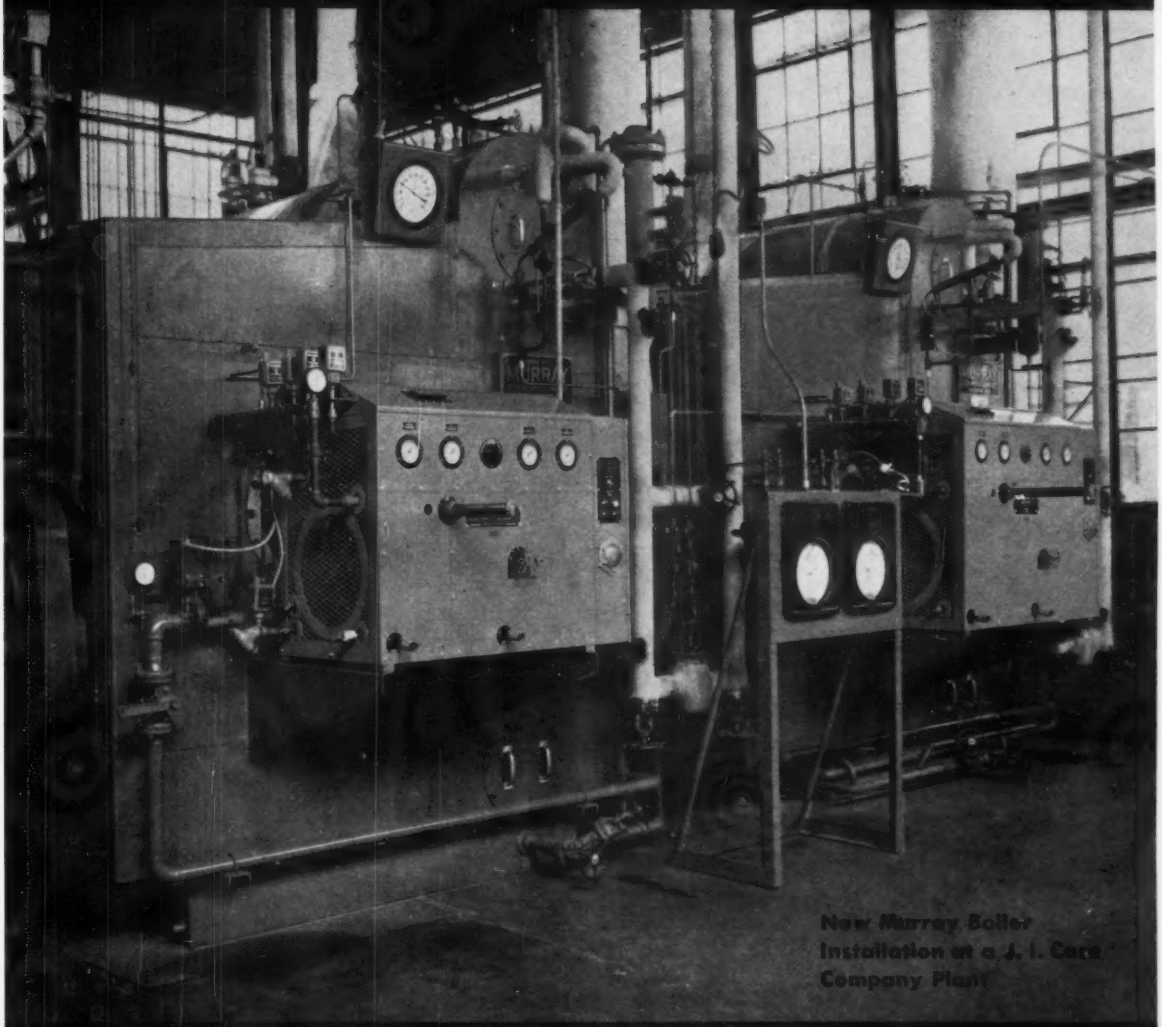
Easy to Install. Mounts in any position. Universal bracket provides for direct mounting on pipe, wall, or wrench head of well or separable bushing. Small and extremely compact, the SENSAIRE transmitter measures only 7¾" x 4¾" x 4½"; weighs only 7 lbs.

For more facts circle 824 on Reader Service Card p 222

MURRAY *Economical, Dependable*

SHOP ASSEMBLED BOILERS

available in sizes from 5,000 LB/HR to 65,000 LB/HR

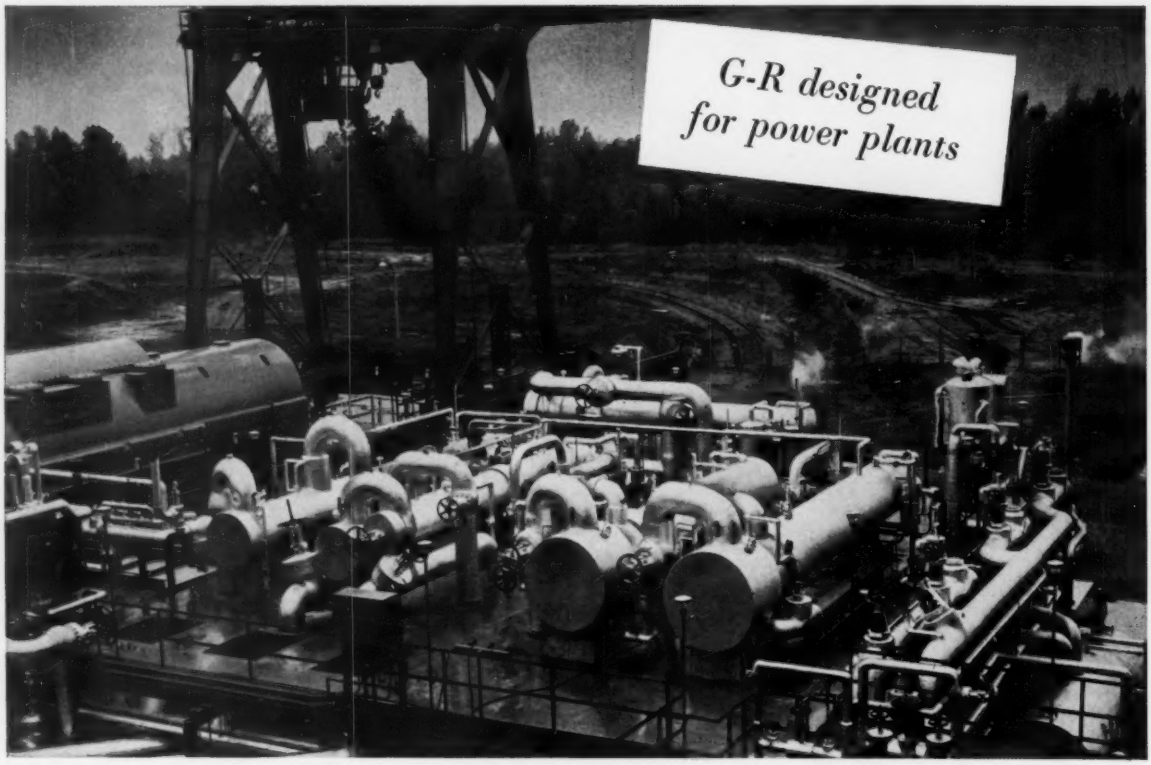


New Murray Boiler Installation at a J. I. Case Company Plant

MURRAY IRON WORKS CO., BURLINGTON, IOWA

Murray Boilers Stand the Test of Time

For more facts circle 825 on Reader Service Card p 222



Three reasons for specifying G-R Feedwater Heaters

SERVICE

Griscom-Russell service—from the design stage through installation to follow-up—is known to be the most complete in the industry. You *know* G-R Heaters will perform properly.

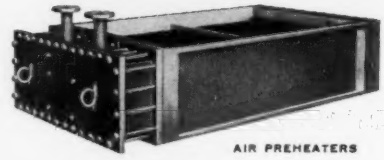
DESIGN AND CONSTRUCTION

90 years of experience plus extensive research contribute to the many *important* features that can be found in G-R Feedwater Heaters. Bundles are easily removable, steam baffling is designed for low pressure losses and efficient distribution, condensate drainage is complete without surging, capacity is guaranteed. These and other features provide the reliable operation and low maintenance that are inherent in G-R designs.

COST

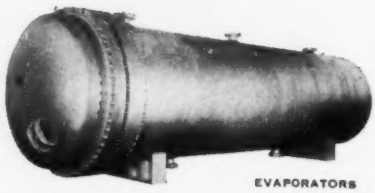
Always competitive, frequently the lowest, always the most economical because you get more in service and lowered operating costs.

Send for Griscom-Russell Bulletin 300.



AIR PREHEATERS

FUEL OIL HEATERS



EVAPORATORS

G-R Designs for Power Generation

Evaporators • Air Preheaters • Fuel Oil Heaters • Storage Tank Oil Heaters • Drain Coolers • Feedwater Heaters • Transformer Oil Coolers • Generator Coolers • Lubricating Oil Coolers

HEAT EXCHANGE EQUIPMENT

FOR THE POWER INDUSTRY

GR-379

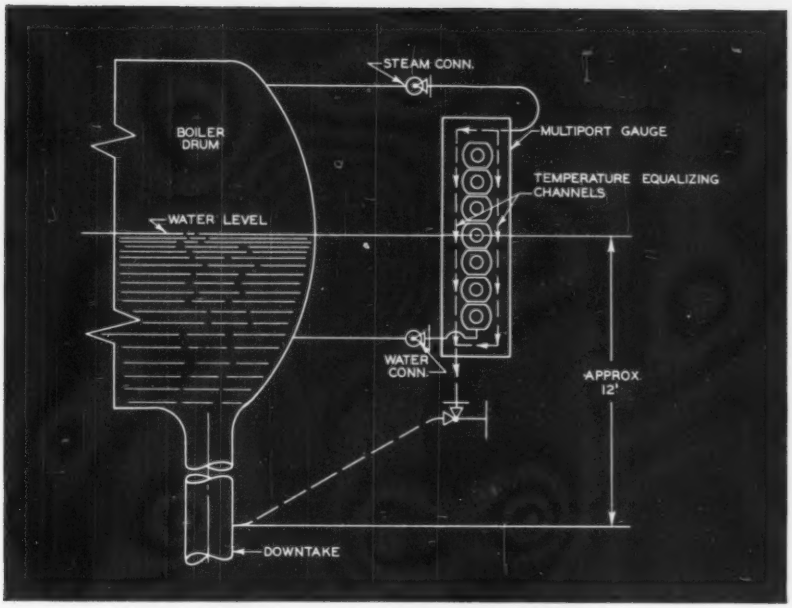
Griscom-Russell

GENERAL PRECISION EQUIPMENT CORPORATION GPE

THE GRISCOM-RUSSELL COMPANY • MASSILLON, OHIO

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

ANOTHER NEW GAUGE DEVELOPMENT BY Diamond



Diagramatic illustration of new Diamond Temperature-Equalizing Multi-Port Gauge installation.

The need for correction of inherent gauge error at high operating pressures is well recognized, but heretofore no satisfactory simple answer has been found. Now, Diamond has developed the Temperature-Equalizing Multi-Port Gauge* to reduce the error in gauge level reading by a simple and fully reliable means.

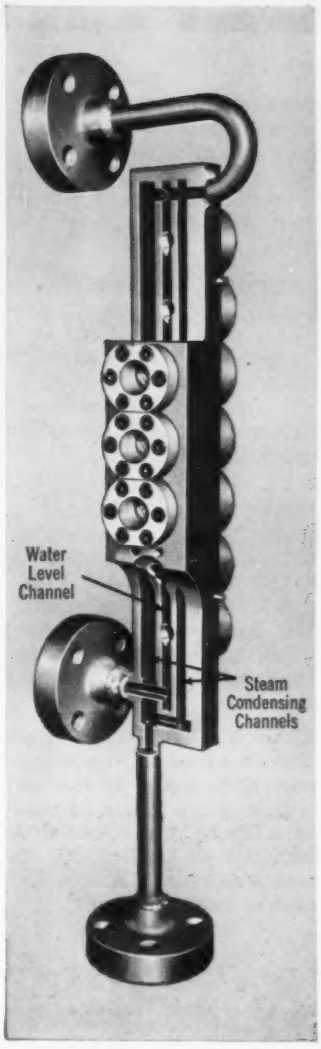
Gauge error (resulting from the gauge temperature being lower than boiler saturation temperature) is substantially avoided by introducing supplementary gauge heating in the form of steam condensing channels. These channels are parallel to the gauge water level channel as illustrated, and serve to heat the gauge level channel by direct conduction of heat from condensing steam through the gauge body itself. No external source of energy or control is required. The heating channels have a natural circulation system independent of the gauge level channel so that no faulty operation can occur under any circumstance.

Ask your local Diamond office or write directly to Lancaster, Ohio for Form 2150U for further information.

*Patent Applied For

8031

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
DIAMOND SPECIALTY LIMITED—Windsor, Ontario



Cut-away sections illustrate independent gauge body heating channels of the new Diamond Temperature-Equalizing Multi-Port Gauge.

For more facts circle 827 on Reader Service Card p 222

DE LAVAL

PX-309

"SELF-CLEANING"
HEAVY OIL CENTRIFUGE

PURIFIES BUNKER OIL FOR DEPENDABLE DIESEL FUEL

TREMENDOUS SAVINGS — In power plants, on ships . . . wherever there are diesel installations, operators report as high as 50% savings on fuel costs by using residual oils. Purified by a De Laval PX 309, these oils necessitate no more maintenance than if you were burning much more costly distillate fuels.

CONTINUOUS OPERATION — One operator reports more than **six months** of continuous operation . . . no shut-down for any reason whatsoever. And that's not unusual with the "self-cleaning" De Laval PX 309. It automatically ejects accumulating sludge while the bowl is running at full speed, a constant efficiency machine that purifies dirty, viscous oil into the equivalent of costly No. 2 oil . . . inexpensively, and dependably.

DUAL FUNCTION—In some installations, it has been found practical to use this one machine for both the clarification of heavy fuel and the purification of diesel lube oil. In cases of this sort, the PX 309 is used to process a day tank of fuel oil. Then, by simply adding a top disc and discharge ring, the machine is converted to a lube oil purifier. The whole conversion takes less than an hour, and the machine is a "self-cleaner" in both operations.

AT YOUR SERVICE—Our Engineering Department and complete Pilot Plant are at your disposal in planning a complete purification system for your particular needs. If you'd like a personal call from a De Laval Sales Engineer, just drop us a line on your letterhead. And for further information about the De Laval PX 309, including specifications and capacities, write for Booklet S. A959. No obligation in either case, of course.

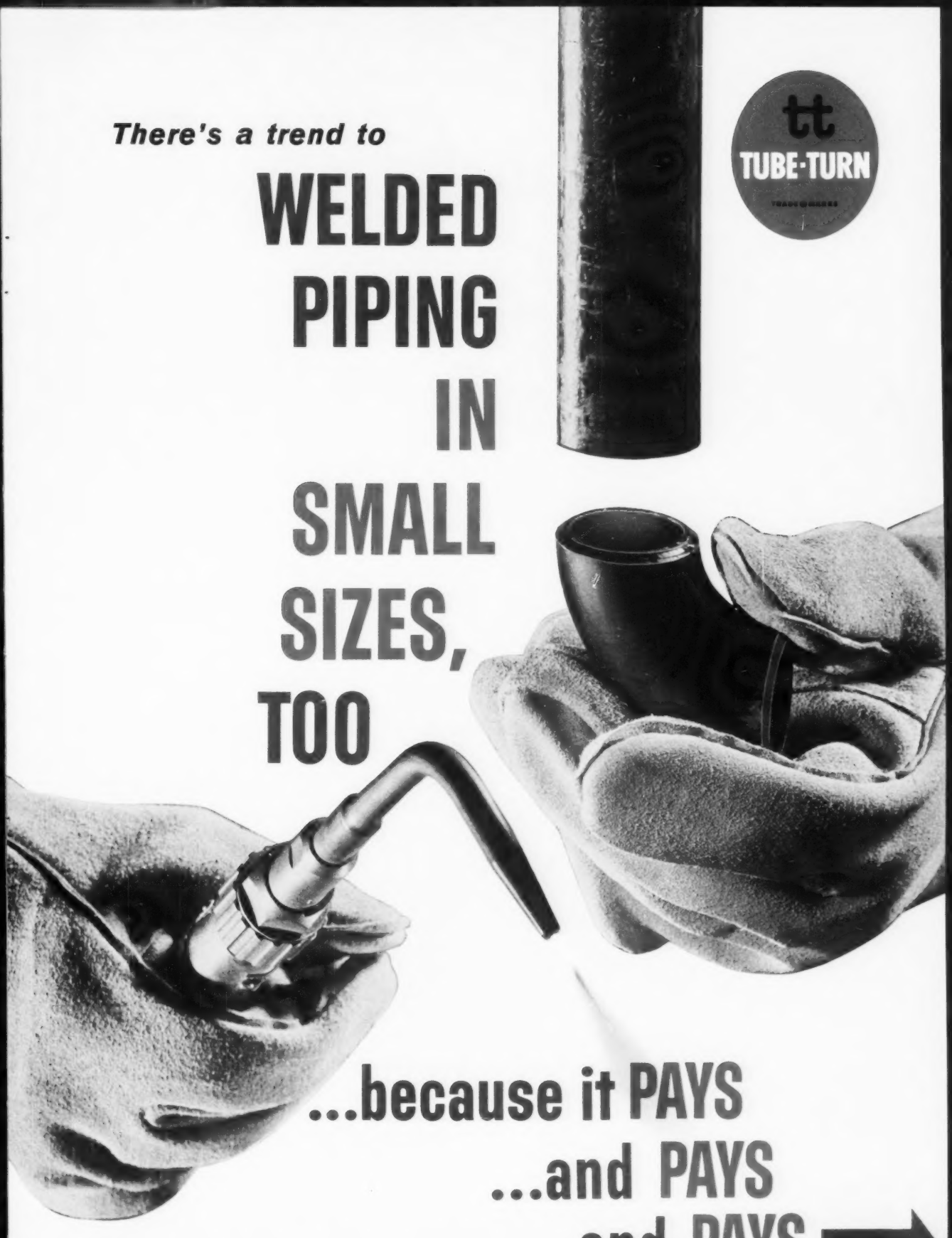
DE LAVAL
SEPARATOR COMPANY

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York • Chicago, Illinois
DE LAVAL PACIFIC COMPANY,
201 E. Millbrae Avenue, Millbrae, Calif.

There's a trend to

WELDED PIPING IN SMALL SIZES, TOO

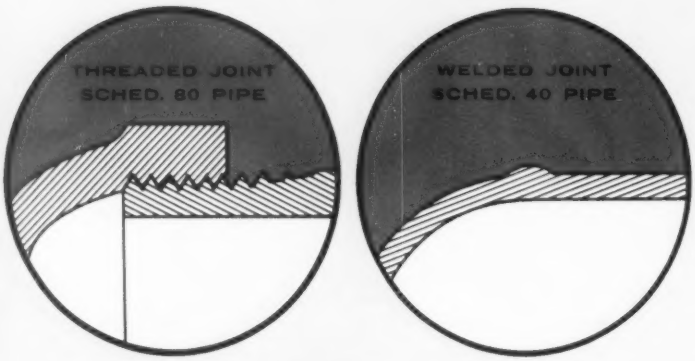
tt
TUBE-TURN



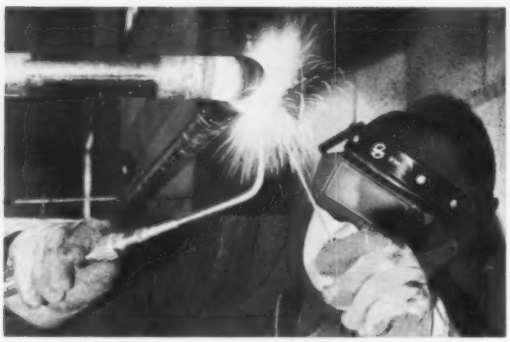
...because it PAYS
...and PAYS
...and PAYS

In small sizes . . . all sizes . . .

welded piping with TUBE-TURN® FITTINGS pays off 3 ways!



SAVES ON MATERIAL. Schedule 40 pipe, butt welded, is stronger in bending and fatigue and has greater thickness for corrosion resistance than Schedule 80, threaded. Hence, welding piping can be lighter . . . can cut material costs 30-50%.



SAVES ON INSTALLATION. Butt welded joints in 1½" piping, such as school heating line shown, averages 7 minutes compared to 8 minutes for threading and tightening fitting. Tools are simple, inexpensive.

MORE INFORMATION—"The Economics of Welding Small, Non-critical Pipe" gives helpful information. Mail the coupon for your free copy.

TUBE TURNS
224 East Broadway, Louisville 1, Kentucky

Please send free copy of "Economics of Welding Small, Non-critical Pipe."

Company Name _____

Company Address _____

City _____ Zone ____ State _____

Your Name _____

Position _____

SAVES ON MAINTENANCE. Butt welded joints are permanently as strong and leakproof as the pipe itself. Photo shows ½" welded water-heat piping for shopping center . . . specified to eliminate maintenance expense.

TUBE-TURN* Fittings and Flanges in sizes from ½" to 42" . . . in all types and materials . . . are available promptly from your nearby Tube Turns' Distributor. All your needs on one order cuts your purchasing red tape.

The trademarks "TUBE-TURN" and "tt" are applicable only to the quality products of Tube Turns.

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

TUBE TURNS

DIVISION OF CHEMETRON CORPORATION
Louisville 1, Kentucky

CHEMETRON

DISTRICT OFFICES: Atlanta • Chicago • Dallas • Denver • Detroit Houston • Kansas City • Los Angeles • Midland (Texas) • New Orleans New York • Philadelphia • Pittsburgh • San Francisco • Seattle • Tulsa

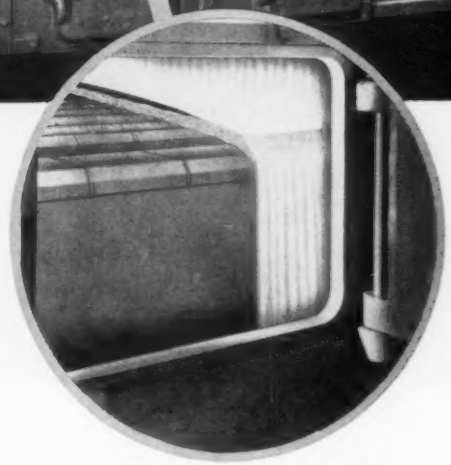
IN CANADA: Tube Turns of Canada Limited, Ridgetown, Ontario
DISTRICT OFFICES: Edmonton • Montreal • Toronto • Vancouver

A STANDOUT UNDER ANY TEST

DETROIT ROTOSTOKER C-C (Continuous Cleaning)

In any test you want to apply DETROIT ROTOSTOKER C-C *(Continuous Cleaning)* will stand out

Detroit RotoStoker C-C (Continuous Cleaning) with reciprocating grates that continuously clean the fire and discharge ash at the front, where it may be taken from the ash pit at floor level if desired, avoiding need for a basement ash bunker. High sustained efficiency, high availability low power for operation — For boiler capacities from 5,000 to 75,000 pounds steam per hour.



Efficiency, availability, flexibility under fluctuating load, ability to burn good or low grade coals or waste materials, durability, low parasite power consumption and low maintenance. RotoStoker C-C scores high on all points.

Among those who have tested the RotoStoker C-C — found it a winner — are such well known names as:

Allied Chemical & Dye Corporation
Alpena Power Company
American Cyanamid Company
American Radiator and Standard Sanitary Corp.
The Electric Auto-Lite Company
Automatic Electric Company
Carlisle Tire & Rubber Company
Columbian Carbon Company
Darling and Company
E. I. du Pont de Nemours and Company
General Motors Corporation
General Tire & Rubber Company
Manchester Board and Paper Company, Inc.
National Gypsum Company
Newberry State (Mich.) Hospital
Pittsburgh Steamship Company
U. S. Dept. of Defense
Wake Forest College

RotoStoker C-C is typical of the Dependable Detroit Line which includes stokers for efficient firing of boilers from 3,000 to 400,000 pounds per hour steam capacity.

DETROIT STOKERS COST LESS: COST EQUALS INITIAL INVESTMENT PLUS UPKEEP PLUS PRODUCTION LOSSES DUE TO EQUIPMENT OUTAGE. THE TOTAL IS LESS WITH DETROIT.

8139

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

NEW IDEAS? I SURE GET PLENTY AT THE POWER SHOW. NO DOUBT ABOUT IT, BILL, I ALWAYS GET A WEALTH OF ENGINEERING INFORMATION BY TALKING TO THE EXHIBITORS' TECHNICAL PERSONNEL. AND THIS IS THE PLACE TO SEE AND COMPARE NEW, COST-SAVING EQUIPMENT.

YES, ED. WE'RE ESPECIALLY CONCERNED RIGHT NOW WITH LOWERING OUR PRODUCTION COSTS, AND SOME OF THE IDEAS I'VE PICKED UP HERE ARE GOING TO HELP DO IT.

You, Too, Can Secure Valuable

at the

23rd National Exposition of POWER & MECHANICAL ENGINEERING

Auspices of ASME

New York Coliseum, December 1-5, 1958

See first-hand the new, cost-saving products of these leading manufacturers—

Partial list of exhibitors as of August 1st.

Abrams, Inc., Morris
Aerco Corporation
Air Conditioning Equipment Corp.
Airetool Mfg. Co
Alco Products, Inc.
Allen-Bradley Co.
Allis-Chalmers Manufacturing Co.
Allis Co., The Louis
Alloy Steel Products Company
American Air Filter Company, Inc.
American Brass Company, The
American Hydrotherm Corporation
American Pullmax Company, Inc.
American-Standard:
Kewanee Boiler Division
Ross Heat Exchanger Division
Anchor Packing Company, The
Anderson Company, The V. D.
Armstrong Machine Works
Armstrong Steam Trap Company
Automatic Switch Co.

B&W Co., Tubular Products Division
Bailey Meter Company
Barber-Colman Company,
Wheelco Instruments Division
Barnes & Jones, Inc.
Barrett-Cravens Company
Bart Manufacturing Corp.
Beaver Pipe Tools, Inc.
Beemer Engineering Company
Bergen Pipesupport Corporation
Bioch Industries, Inc.
Biddle Co., James G.
Bituminous Coal Institute
Black, Sivalls & Bryson, Inc.
Boston Gear Works
Bragar Co., Inc., Norman
Braun & Co., C. F.
Brown Boveri Corporation
Bruckner Machine & Tool Co.
Bruning Company, Inc., Charles
Buck Manufacturing Company
Burling Instrument Company, Inc.
Byers Company, A. M.
Byron Jackson, Div. of Borg-Warner

Cambridge Instrument Company, Inc.
Carey Manufacturing Co., The Philip
Carpenter and Paterson, Inc.
Carpenter Steel Company, The,
Alloy Tube Division
Chemiquip Company
Chiksan Company
Clark Bros. Co.,
Division of Dresser Operations, Inc.
Clayton Manufacturing Company
Cleaver-Brooks Company
Cobon Plastics Corporation
Cobra Metal Hose,
Div. D K Mfg. Co.
Cochrane Corporation
Collins Machinery Corporation
Combustion Control Division, E.C.A.
Commander Manufacturing Company
Conax Corporation
Continental Electric Equipment Co.
Couse & Bolten Co.
Crawford Fitting Company
Curtiss-Wright Corporation:
Metals Processing Division
Research Division
Cyclotherm, Division, National—U. S.
Radiator Corporation

Dampney Company, The
Dayton Rubber Company, The
De Laval Steam Turbine Company
Delta Equipment Company
De Walt, Div., American Machine &
Foundry Company
Diamond Expansion Bolt Co., Inc.
Diehl Manufacturing Company
Dumore Company, The
Durabla Manufacturing Company

Earle Gear & Machine Company, The
Eastern Power Equipment Corp.
Eddington Metal Specialty Company
Electric Products Company, The
Electro Dynamic,
Division of General Dynamics Corp.
Electronics Corporation of America,
Combustion Control Division
Epic, Inc.
Equipto Division Aurora Equipment Co.
Eutectic Welding Alloys Corporation

Falcon Alarm Company
Falstrom Company
Fee & Mason Mfg. Co., Inc.
Flanders Filters Inc.
Flintkote Company, The,
Van-Packer Company Division
Flow-Actuated Control Co.
Fluid Controls Co. of New York, Inc.
Foley Manufacturing Company
Foster Engineering Company
Foxboro Company, The
Furnas Electric Company

Garlock Packing Company, The
Gems Co.
General Controls Co.
General Dynamics Corporation,
Electro Dynamic Division
General Fireproofing Co., The
Globe Company, The, Products Div
Golden-Anderson Valve Specialty Co.
Graham Machine Tool Co.
Graver Water Conditioning Co.,
Division of Union Tank Car Co.
Green Fuel Economizer Co. Inc., The
Griffin Equipment Corporation
Grinnell Company, Inc.
Gulf Oil Corporation
Gulton Industries, Inc.

Hamon, Inc.
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Janney Cylinder Company
Jarco Services, Inc.
Jenkins Bros.
Jerguson Gage & Valve Co.
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New Hermes Engraving Machine Corp.
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A Div. of Pfaudler Permutit Inc.
Philadelphia Gear Works, Inc.
Philadelphia Pump,
Division of American Meter Co.
Pick Manufacturing Co.
Pittsburgh Corning Corporation
Plant Engineering
Poole Foundry & Machine Company
Porter & Co., Inc., H. W.
Power, 330 West 42nd St.
Power Chemical Co.
Power Engineering
Power Industry

Rapid Electric Company
Raybestos-Manhattan, Inc.
Raymond Corporation, The
Republic Steel Corporation,
Steel and Tubes Division
Research-Cottrell, Inc.
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Ric-wil Incorporated
Ridge Tool Company, The
Robinson, Inc., John R.
Ross Heat Exchanger

Sarco Company, Inc.
Scam Instrument Corporation, The
Schaub Engineering Co., Fred H.
Schrader's Son, A.,
Div. of Scovill Mfg. Co., Inc.
Sheldon Machine Company, Inc.
Shell Oil Company
Sier-Bath Gear & Pump Co.
Smith Corporation, A. O.
Southern Power & Industry
Spence Engineering Company, Inc.
Spencer Turbine Company, The
Squires Company, The C. E.
Stephens-Adamson Mfg. Co.
Sticht Co., Inc., Herman H.
Strong, Carlisle & Hammond Co.
Struthers Wells Corporation
Sumco Engineering Company
Superior Combustion Industries, Inc.

Texas Company, The
Thomas Flexible Coupling Company
Thomas' Register of American Mfrs.
Titusville Iron Works,
Div., Struthers Wells Corp.
Toledo Pipe Threading Machine Co.
Trerice Company, H. O.
Troy Engine & Machine Company

United States Steel Corporation

Valcor Engineering Corporation
Van-Packer Company,
Division of the Flintkote Company
Vapor Heating Corporation
Velan Engineering Ltd.
Viking Pump Company
Vogt Machine Co., Henry
Voss Co., Inc., J. H. H.

Waldron Corporation, John
Walker, Crosweller and Co., Ltd.
Wallace & Tiernan Incorporated
Warrick Co., Charles F.
Wells Manufacturing Corporation
West Instrument Corporation
Wheelco Instruments,
Division, Barber-Colman Company
Wiedeke Company, The Gustav
Wilson, Inc., Thomas C.
Wing Mfg. Co., L. J.

Yarnall-Waring Company
York Company, Inc., Otto H.
York Separators, Inc.
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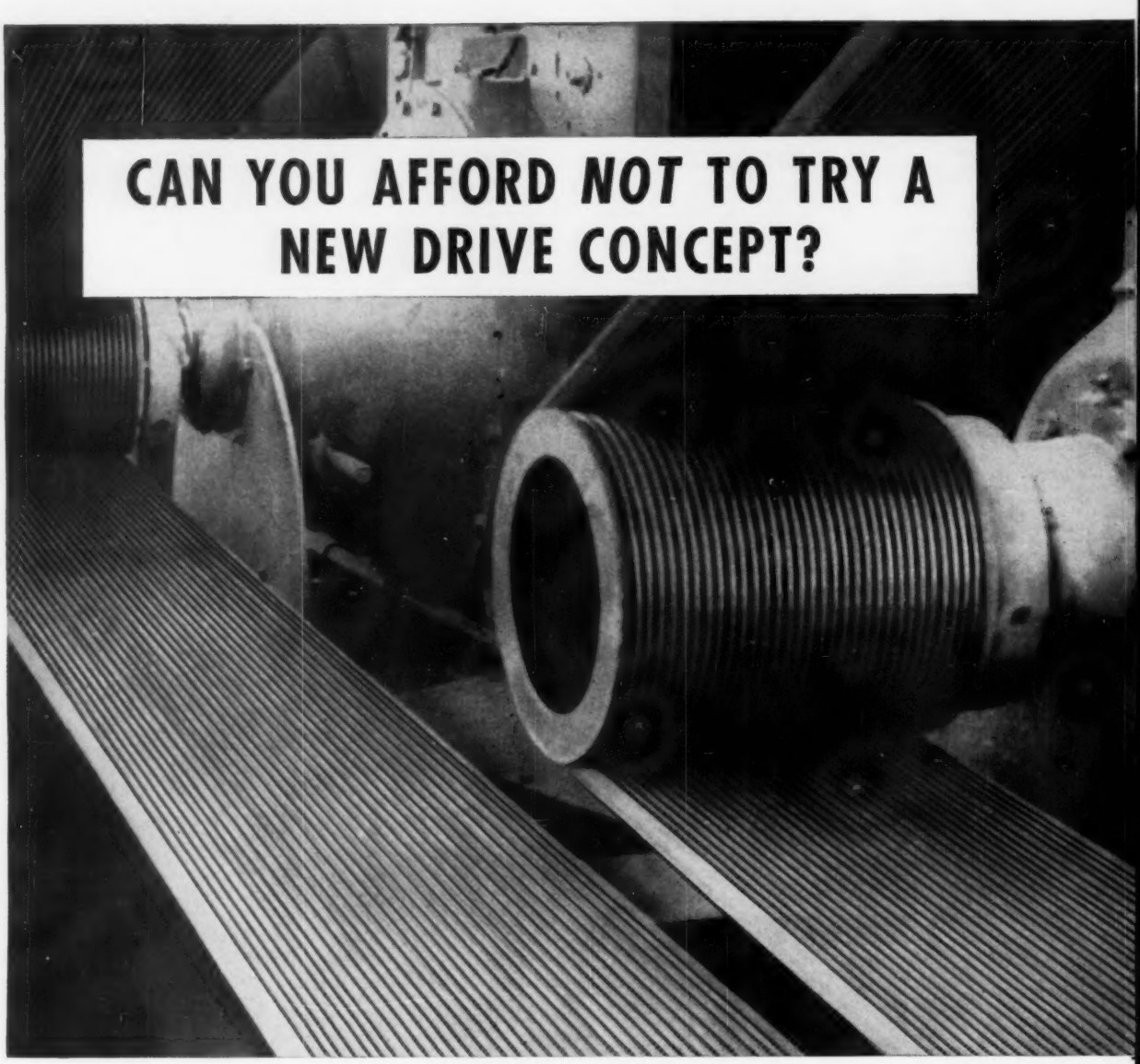


R/M Poly-V® Drive Delivers More Power in Less Space

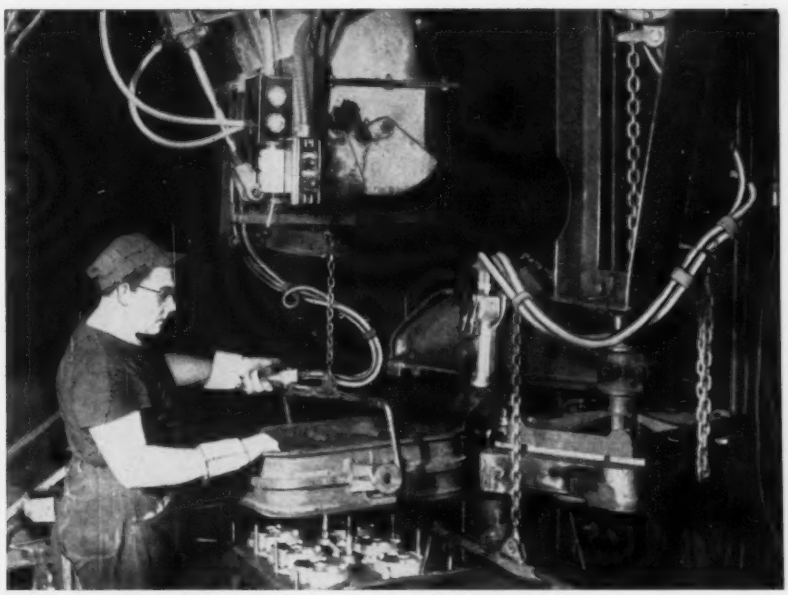
. . . "More Use for Your ~~per~~ Dollar"

Patented new design gives Poly-V Drive up to 50% more power capacity than a conventional V-drive of equal width . . . equal power in as little as 2/3 the width! Single unit V-ribbed belt permits *narrower drive sheaves . . . less shaft overhang . . . less drive weight.* Drive features add up to a new standard in trouble-free drive performance never before possible for heavy duty power driven equipment.

- Eliminates Multiple-Belt "Length Matching" Problems
- Maintains *Constant* Speed Ratios — *No* Load to *Full* Load
- Less wear on belt and sheaves
- *Two* Belt Cross Sections Meet *Every* Heavy Duty Power Requirement
- Reduces Belt *and* Sheave Inventories to a Minimum

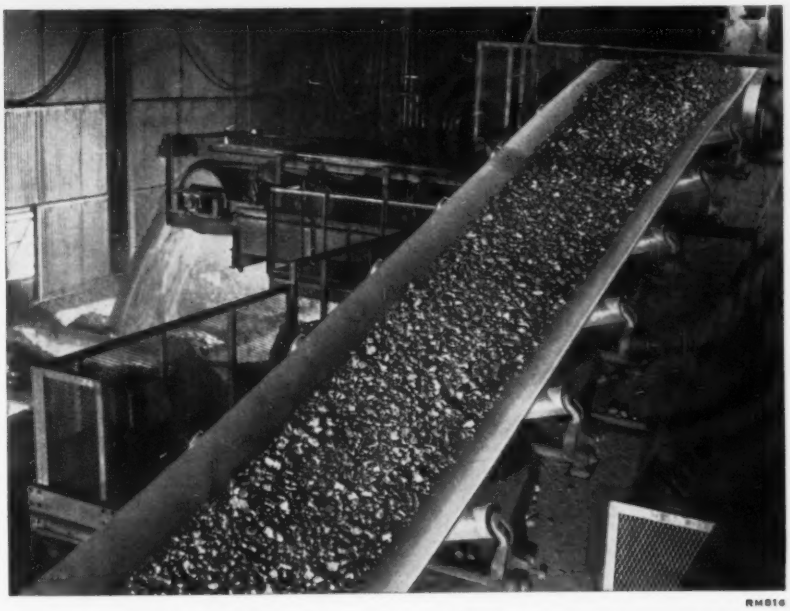
Investigate advantages of *new* Poly-V* Drive for your application. Write for Bulletin #6638 . . . or discuss your requirements with an R/M representative.

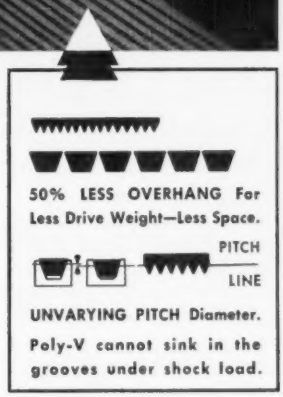
*Poly-V is a registered Raybestos-Manhattan Trademark.



ALLFLEX HOSE — First hose of its type for all-purpose use with air, water, oil, gases—even mild chemicals. Strong, yet light and kinkless. Flexible, has no pre-set twist—coils and uncoils *in any direction*. Write for Bulletin #7075.

RAY-MAN CONVEYOR BELT — Double compensation relieves stress of outer plies, assures longer life for handling bulk materials. Tough, flexible, resists gouging and tearing. High fastener holding ability. Types available for heat, oil, static resistant use, package and table-top installations. Write for bulletins.

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Poly-V cannot sink in the grooves under shock load.

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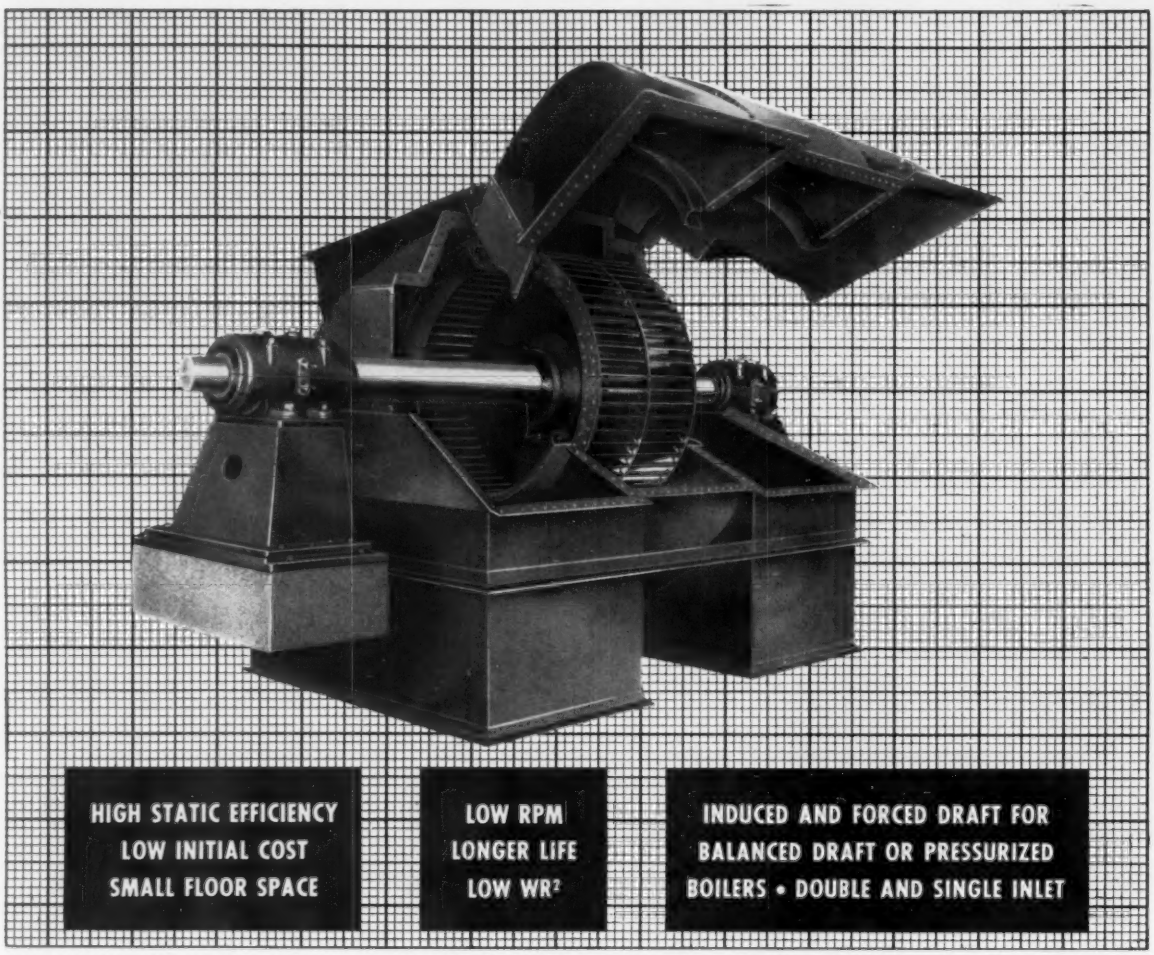
AMERICAN BLOWER SIROCCO FANS



Look for low initial cost, reduced operating costs, guaranteed performance ratings, minimum maintenance and space requirements. You'll find them *all* in American Blower Sirocco mechanical draft fans.

Specially designed for induced-draft and forced-draft work, Sirocco Fans feature die-formed, forwardly inclined blades for high static efficiency at low rpm's. Streamline, low-turbulence inlets also contribute to high efficiency. And for longer service life, Sirocco Fans have heavy-duty rim and hub plate construction . . . heavy, steel-plate housings and inlets. Special erosion-resistant features are available, as well.

For high efficiency, low cost over the entire operating range, couple Sirocco Fans with American Blower *Gyrol*® Fluid Drive. Infinitely variable in speed, Gyrol Fluid Drive matches fan speed to boiler demand; pays off in longer life for fan wheels and bearings; quieter operation.

If you are investigating mechanical-draft equipment for new or existing installations, take advantage of our experience in air handling. Call your nearby American Blower branch office, today. Or write: American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

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If you need condenser and heat exchanger tubes for critical service...

Specify **Phelps Dodge**... a major supplier for nuclear projects!

Phelps Dodge condenser and heat exchanger tubes are currently in use in nuclear energy applications where highest quality and exacting specifications are essential.

Every Phelps Dodge tube intended for use in a nuclear project undergoes a series of severe tests to assure rigid conformance to the required specifications and ability to perform under the rigorous service conditions found in this highly specialized field. Testing facilities used by Phelps Dodge cover not only standard ASTM specifications but also include these special non-destructive tests:

- Eddy-current inspection
- Dye penetrant test
- Ultrasonic inspection

To keep pace with the steadily growing importance of the nuclear power field, Phelps Dodge will soon open one of the largest tube mills in the world at South Brunswick, N. J. This mill will have the most modern automatic tube fabricating machinery, the finest research laboratories and the most advanced testing equipment.

Inquiries regarding your condenser and heat exchanger tube needs, particularly those requiring Electronic and Penetrant Tests, are invited.

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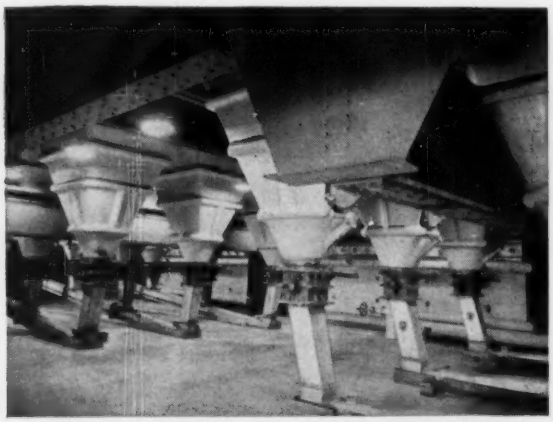
300 PARK AVENUE, NEW YORK 22, N. Y.

PD

How Commonwealth Edison Turned a Fly Ash Problem Into Profit



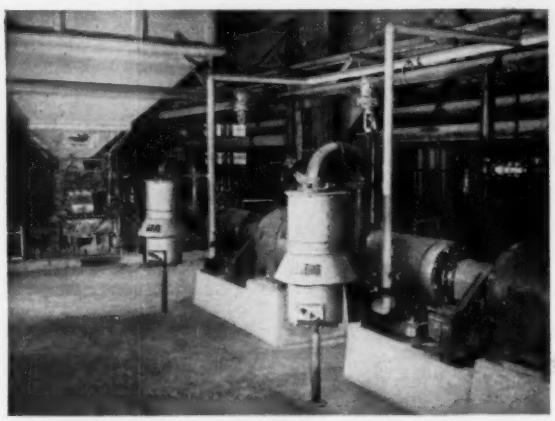
F-H AIRSLIDE FLUIDIZING CONVEYORS ANGLE DOWNWARD from precipitator hoppers, move air-activated ash to 20-ton central surge hoppers under floor. There are few moving parts.

At Commonwealth Edison's State Line Station, about 350 tons of fly ash a day had to be wet down, loaded, and trucked to suitable dumping sites.

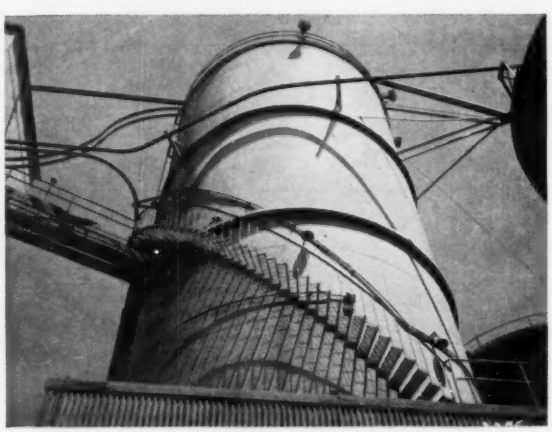
Waste becomes profit. Today, the plant burning a peak load of 5000 tons of coal daily collects dry fly ash automatically in a totally enclosed Fuller-Kinyon system. The ash is conveyed from precipitators to storage bins and silos, where it's sold as a by-product. Manpower: just three men, one at the main control panel and two bagging the ash for sales to local contractors.

Air and gravity do the work. F-H Airslide® conveyors fluidize dry fly ash by a column of low-pressure air for easy movement by gravity to central surge hoppers. Then, a Fuller-Kinyon pump under each hopper drives the ash by air through a five-inch line to storage. The system is practically maintenance-free. There are few moving parts to foul or wear out.

Large and small plants can get the benefits of Fuller-Kinyon fly ash handling. Capacities range from 100 to 8,000 cubic feet an hour. F-H Airslide and Fuller-Kinyon conveying lines can be curved to avoid beams and other obstacles. Low-pressure air provides power inexpensively and installation costs are significantly less than other types of conveying systems. Write for detailed information in Bulletin FF-49-1.



FULLER-KINYON PUMPS AND COMPRESSORS under surge hoppers propel ash to bins and silos at 20 tons an hour. Fluidized by air, the abrasive, 300°F. ash moves without injuring system.



BULK SILOS receive air-conveyed ash through Fuller-Kinyon pipe-lines. Farthest silo is 1,000 feet from pumps. Over 50% of fly ash is bagged and sold as a by-product.

Fuller
....pioneers in harnessing AIR

1335
G-203

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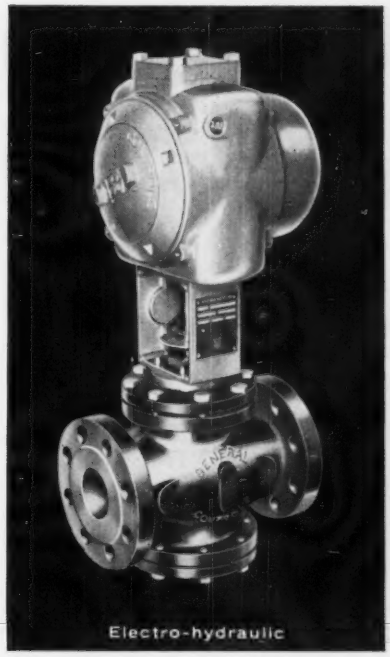

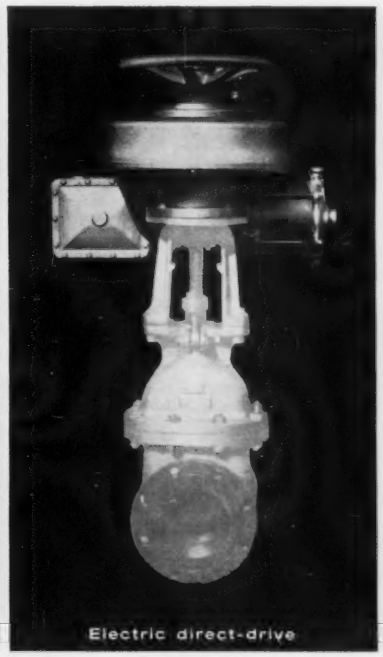

WHAT'S THE BEST VALVE OPERATOR FOR YOUR PARTICULAR JOB?

Obviously, there is no single operator which is "best" for every job. That's why General Controls offers all three, leaving the choice up to you.

Take the famous General Controls **HYDRAMOTOR**, for example. You'll find this powerful electro-hydraulic operator ideal for line sizes up to 8" for high-pressure, high-flow applications. Two-wire, slow-opening, fail-safe.

For the really big jobs, line sizes up to 60", it's the General Controls **TORK-MASTER**. This gear-driven electric operator can be adapted to new or old systems—*and with a minimum of costly down-time during the changeover.*

For heavy duty proportioning applications, you'll find the **HAMMEL-DAHL** air-operated diaphragm valve worth looking into. *And no electrical control or power circuits are required in proportioning operations.*

No matter which you select for your particular job, the important thing to remember is: *General Controls is a single source for all three types . . . and in all standard sizes.* For full information, expert field help, write today to

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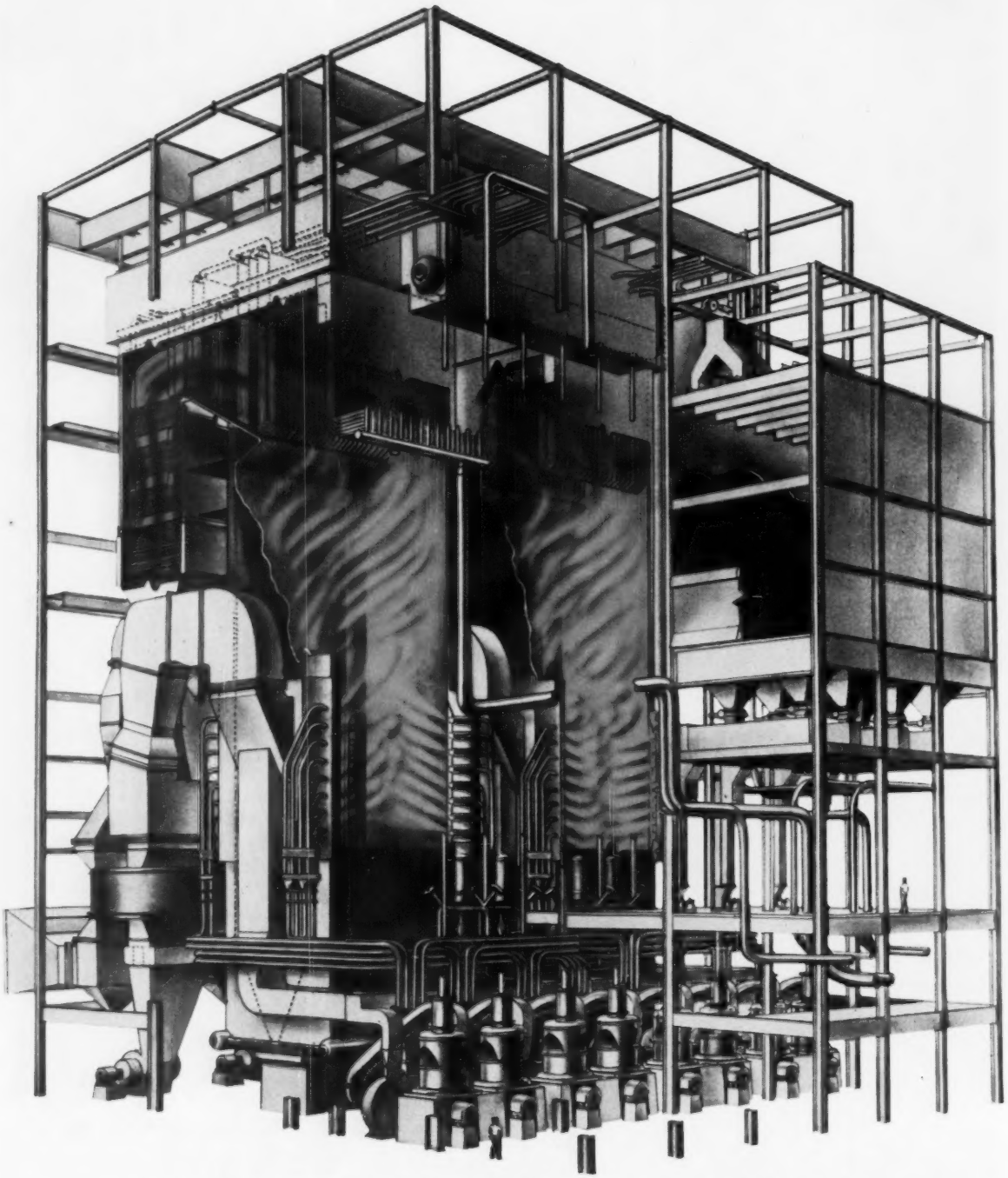
C-E earns an in the 2400 psi



C-E CONTROLLED CIRCULATION TWIN-FURNACE BOILER

Controlled circulation units of the twin or divided furnace type have amply demonstrated their suitability for high-pressure, high-capacity requirements.

overwhelming preference throttle pressure range

Recent years have seen a marked trend toward the use of the 2400-lb *throttle* pressure, and indications are that this will be the prevailing pressure for units in the 200 MW-up class for some time to come.

The following list of C-E Boilers installed, under construction or on order, reveals the *extent of Combustion's experience* in the design, manufacture and operation of 2400-lb boilers. The total electric generating capacity of these boilers (6,592,000 kw) accounts for well over half of *all* the 2400-lb capacity ordered to date by American utilities.

Another significant aspect of present American practice in this pressure area is the recognition of the C-E Controlled Circulation Boiler as *the design best suited to use of the 2400-lb cycle.* The extent of this recognition may be judged from the fact that 30 of the 33 units listed are of this design. The other 3 are C-E Sulzer Monotube Steam Generators.

C-E Boilers* for 2400-lb Throttle Pressure

COMPANY	STATION	NO. OF UNITS	STEAM TEMP. F	CAPACITY—kw TOTAL
Central Hudson Gas & Electric Corp.	Danskammer	2	1050/1000	250,000
Cincinnati Gas & Electric Co.	Beckjord	1	1055/1005	156,250
Cincinnati Gas & Electric Co.	Miamifort	1	1055/1005	156,250
Cleveland Electric Illuminating Co.	Eastlake	1	1050/1050	187,500
Cleveland Electric Illuminating Co.	Ashtabula	1	1050/1050	225,000
Consumers Power Co.	Dan E. Karn	1	1050/1050	250,000
Consumers Power Co.	Port Sheldon	2	1050/1000	500,000
Dayton Power & Light Co.	Tait	2	1050/1000	260,000
Detroit Edison Co.	St. Clair	1	1050/1000	325,000
Duke Power Co.	Allen	2	1050/1000	330,000
Duke Power Co.	Allen	2	1050/1000	550,000
Duke Power Co.	Lee	1	1050/1000	165,000
Metropolitan Edison Co.	Portland	1	1050/1050	165,000
Niagara-Mohawk Power Corp.	Huntley	2	1050/1000	400,000
Niagara-Mohawk Power Corp.	Dunkirk	2	1050/1000	400,000
Pennsylvania Electric Co.	Shawville	2	1050/1000	330,000
Pennsylvania Power & Light Co.	Brunner Island	1	1005/1005	300,000
Philadelphia Electric Co.	Schuylkill	1	1050/1000	175,000
Potomac Electric Power Co.	Dickerson	2	1050/1000	350,000
South Carolina Electric & Gas Co.	McMeekin	2	1050/1000	250,000
Tennessee Valley Authority	Widows Creek	1	1053/1003	500,000
Virginia Electric & Power Co.	Chesterfield	1	1000/1000	167,000
Virginia Electric & Power Co.	Possum Point	1	1000/1000	200,000

*The above list covers American utilities only. Abroad, too, the C-E Controlled Circulation Boiler has achieved a predominant position for 2400-lb applications, evidenced by orders placed with C-E or its licensees for 21 units with an aggregate capacity of 5,270,000 kw.

COMBUSTION ENGINEERING

C-181

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; TOOL PIPE

For more facts circle 836 on Reader Service Card p 222

BRIDGEPORT "T" MEN* IN ACTION

**Technical Service Men*

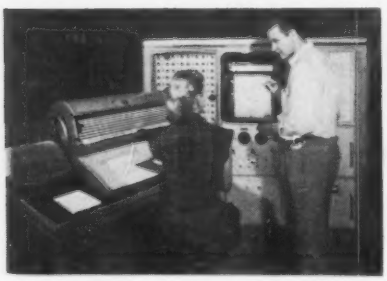
The Case of the Telltale Tube

When the tube came into the lab it was covered with the scars of a savage attack. An obvious case of malicious assault. Accompanying clues were a completed Bridgeport Corrosion Questionnaire and a letter of explanation. The customer—a rendering plant—wanted help fast. He asked for recommendations from the Bridgeport Technical Service Staff.

A sample of the tube was rushed to the Spectrograph, an instrument that analyzes 14 elements in less than 5 minutes. Areas of corrosive attack and cracks were examined on a Metallograph. The tube was found to be phosphorized aluminum brass, and tube failure due to stress corrosion from vibration and ammonia on the product side.

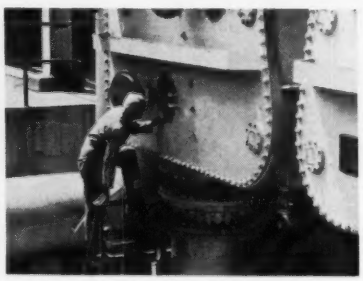
"T" Man telephoned customer's chief engineer and notified him of findings. They discussed plant's operation and the products rendered. Neither ammonia nor vibration could be eliminated. From extensive experience in similar cases, "T" Man made several recommendations which would solve the problem. The customer installed Bridgeport 70/30 cupro nickel tube for greater resistance to ammonia and other organic products. Results? Unit operating with top efficiency and economy. No evidence of tube failure since. Case closed.

This is one of many cases from the files of Bridgeport's Technical Service Men. Practical field experience, modern laboratory equipment and expert corrosion engineers assure Bridgeport customers of maximum service and efficiency from their power and process equipment. Learn more about Bridgeport condenser and heat exchanger tubes and services. Call your nearest Bridgeport Sales Office today.



Spectrographic analysis determines tube composition. Can analyze 14 elements in less than 5 minutes.

Metallographic examination reveals type of tube failure from which cause can be determined.



Follow-through—Bridgeport "T" man visits plant to review effects of recommended solutions.

BRIDGEPORT CONDENSER TUBES

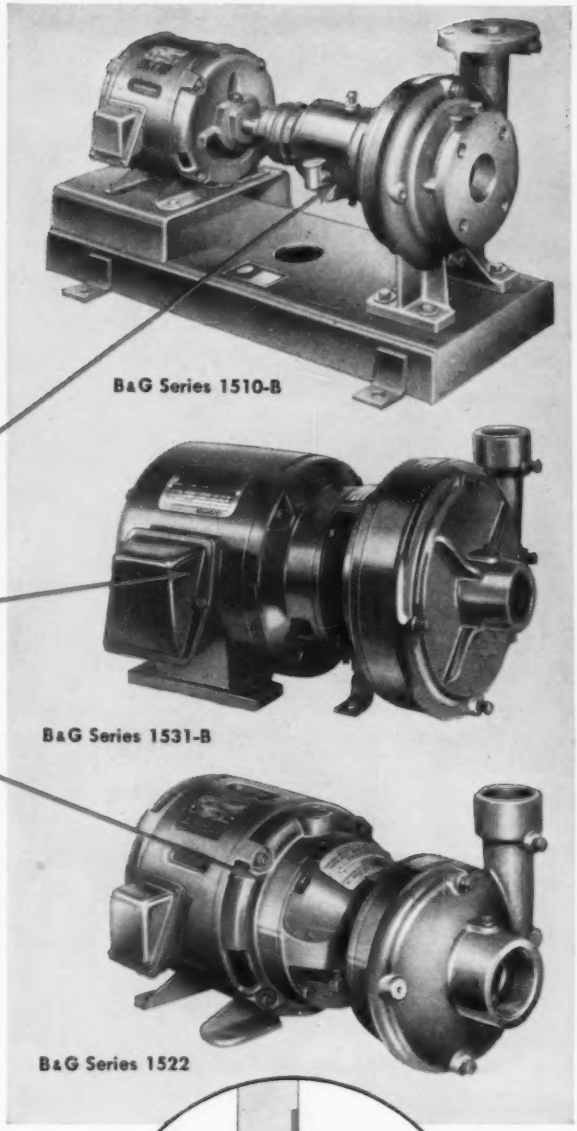
Bridgeport Brass Company, Bridgeport 2, Connecticut

Sales Offices in Principal Cities • In Canada: Noranda Copper and Brass Limited, Montreal

BRASS Bridgeport CO

For more facts circle 837 on Reader Service Card p 222

WHEN YOU NEED A *GOOD* PUMP IN A *BIG* HURRY...



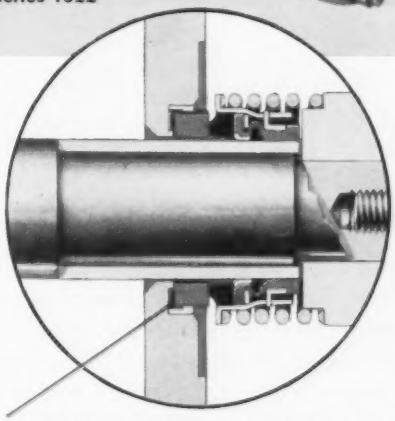
ORDER A B&G STOCK PUMP!

B&G maintains a factory stock of the most commonly used sizes of centrifugal pumps for immediate delivery. Base mounted and integral-motor pumps as listed in B&G Stock Pump Catalog are available in capacities to 325 GPM, heads to 140 ft.

Why B&G Centrifugal Pumps give years of trouble-free service is evident from their design features. Vertical split case construction permits removal of the bearing bracket without disconnecting pipe lines or motor leads. Special alloy steel shafts are super-finished and over-sized to keep deflection at a minimum.

Leak-proof operation is assured by the "Remite" Mechanical Seal—an exclusive B&G development. "Remite" is so hard it will cut glass—eliminates packing rings and gland adjustment. Seal is self-lubricating.

Send the coupon for catalog



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COMPANY
Dept. FL-36, Morton Grove, Illinois
Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

BELL & GOSSETT CO., Dept. FL-36, Morton Grove, Ill.
Please send a copy of the B&G Stock Pump Catalog CSP-257A.

Name.....

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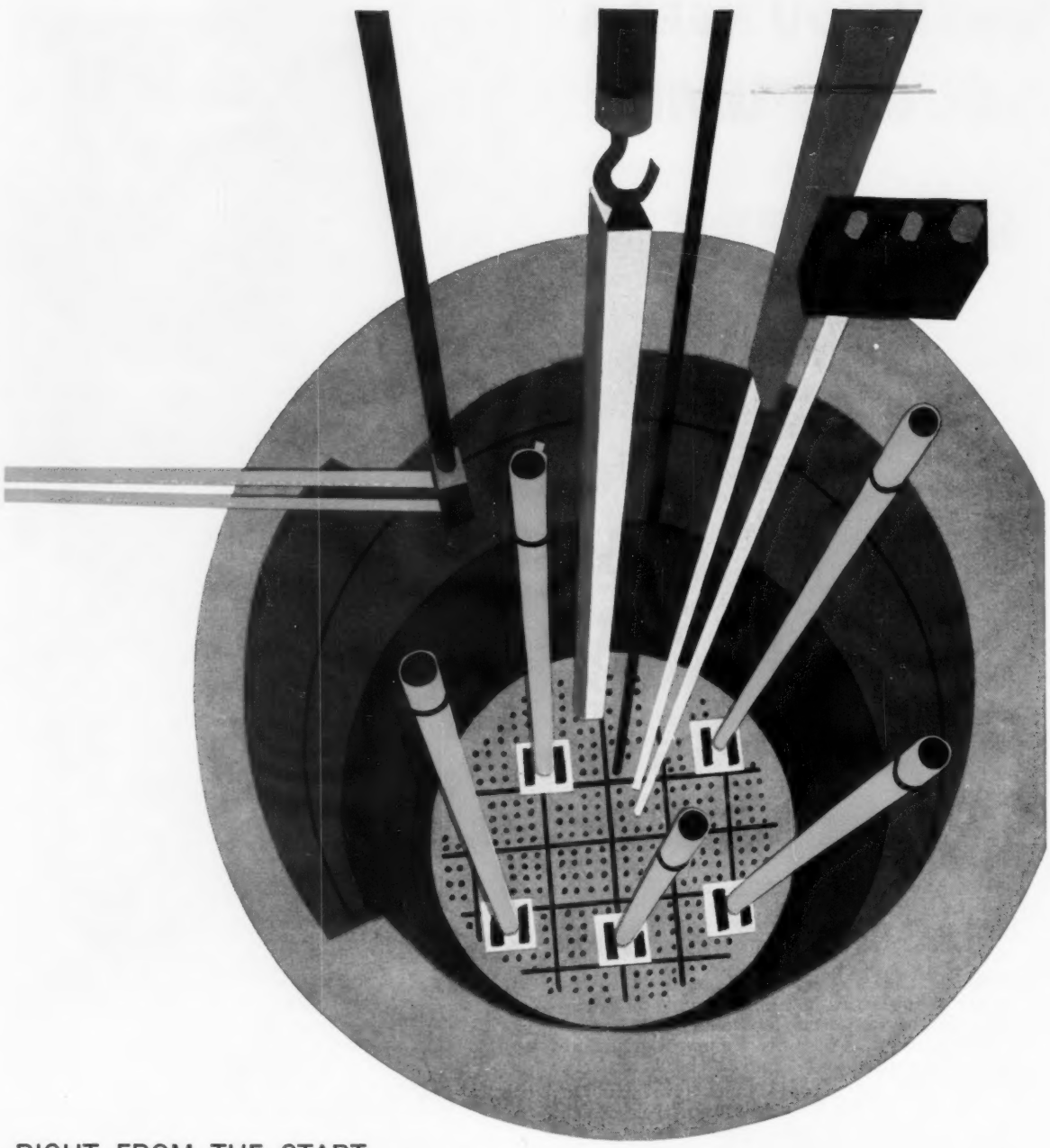
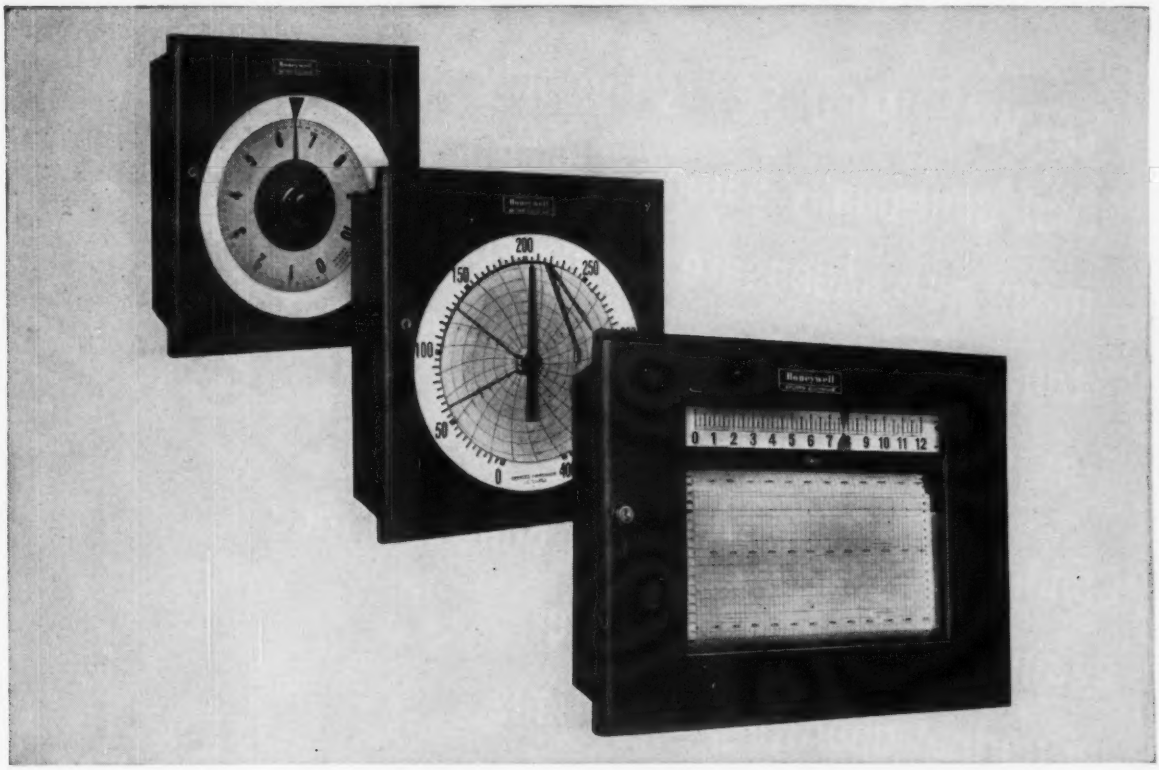


RIGHT FROM THE START . . .

When piping costs come close to the million mark — when the installation is vast, and the leeway for error is small — a piping job must be right from the start to finish. Grinnell assures this through complete one-company control and responsibility. From interpretive engineering — through exclusive methods of prefabrication and testing of pipe and hanger units — to precision assembly and delivery, the job is all done by Grinnell, as only Grinnell can do it. The result: installations of any size, at costs known before you start, with assured performance. Grinnell Company, Inc., Providence, R.I.

Current Grinnell piping responsibilities. Enrico Fermi Atomic Power Plant, Michigan; Ohio Power Company, West Virginia; National Aniline Division of Allied Chemical & Dye Corporation, Virginia; Memphis Light, Gas and Water Division, Tennessee; Aluminum Company of America, Indiana; South Carolina Electric & Gas Company, South Carolina; Duke Power Company, North Carolina; Union Bag-Camp Paper Corp., Virginia; Pennsylvania Power & Light Company, Pennsylvania; Holyoke Water Power Company, Massachusetts

GRINNELL



the *ElectroniK* recorder or indicator is a thousand instruments in one

An *ElectroniK* instrument adapts easily to your changing needs, never becomes obsolete. Its remarkable versatility is made possible by the many measuring circuits . . . many types of records or indications . . . many pen or print wheel speeds . . . and the wide variety of functions that can be incorporated in the instrument.

You can convert most *ElectroniK* instruments to practically any scale, simply by soldering appropriate kit-supplied range resistors into the measuring circuits. And you have a choice of more than 575 *standard* charts and scales in strip chart instruments (similar large choice in indicators and circular chart models). You can change chart speeds from one half to four times the basic speed, with a simple gear change.

Use *ElectroniK* instruments to measure temperature, pressure, flow, pH, chemical concentration, voltage, speed—*any* variable that's translatable into a d-c signal.

Unitized construction lets you transfer complete control units from one *ElectroniK* instrument to another. Cases are designed for both surface and flush panelboard mounting. With auxiliary switches, the instrument works in conjunction with audible or visual alarms and safety cutouts.

Your nearby Honeywell field engineer can help you gain the advantages of *ElectroniK* versatility in specific applications. Call him today. He's as near as your phone.

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Honeywell

H HONEYWELL *First in Control*

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YARWAY IMPULSE* is the only steam trap that continually samples fluid in the line to maintain condensate discharge close to steam temperature, eliminating condensate as soon as it forms.

Condensate seals the small control orifice against steam leakage under all normal operating conditions.

Here's why your best steam trap buy is Yarway Impulse—

1. GETS EQUIPMENT HOT FAST—AND KEEPS IT HOT
2. ONLY ONE MOVING PART
3. LOW MAINTENANCE
4. SMALL SIZE—LIGHT WEIGHT
5. GOOD FOR ALL PRESSURES
6. NON-FREEZING
7. COMPLETE LINE FOR EVERY REQUIREMENT

* A COMPLETE LINE OF STEAM TRAPS, ALL OPERATING ON A PROVEN THERMODYNAMIC PRINCIPLE.

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Manufactured by YARNALL-WARING CO., 100 Mermaid Ave., Philadelphia, Pa.
Stocked and sold by 270 Industrial Distributors
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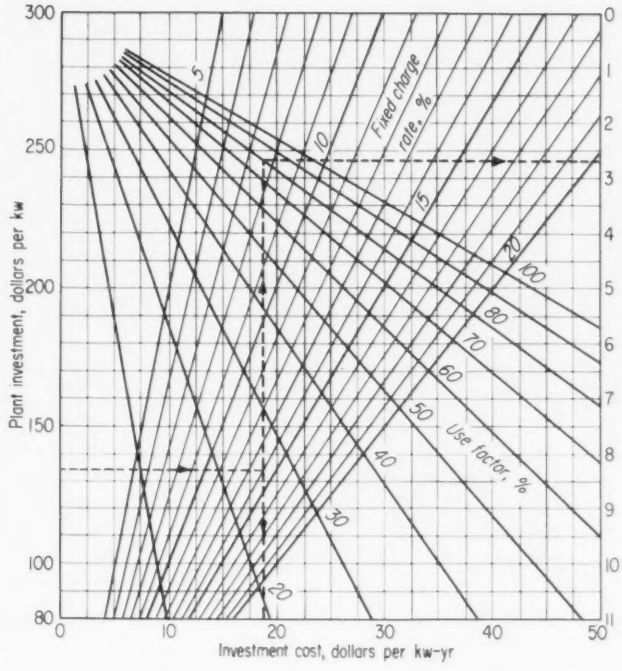
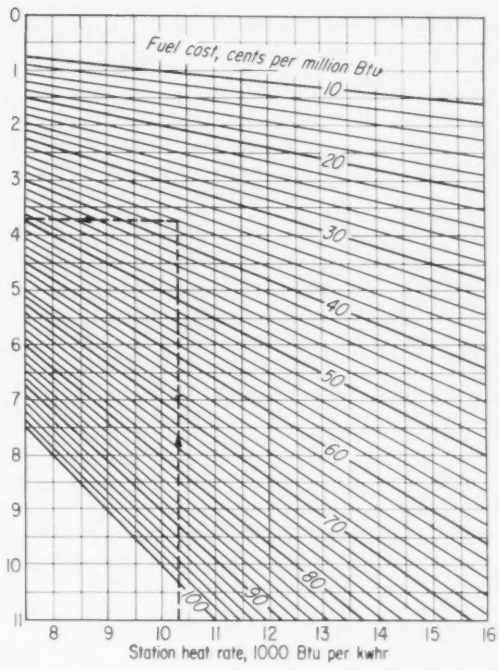
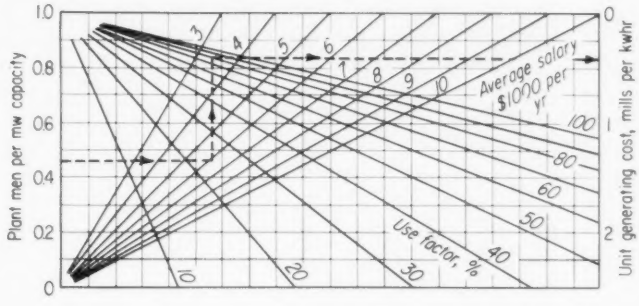
Power's data sheet

No. 314


Plant investment, dollars per kw
Investment cost, dollars per kw-yr
Unit generating cost, mills per kwhr
Fixed charge rate, %
Use factor, %





Unit generating cost

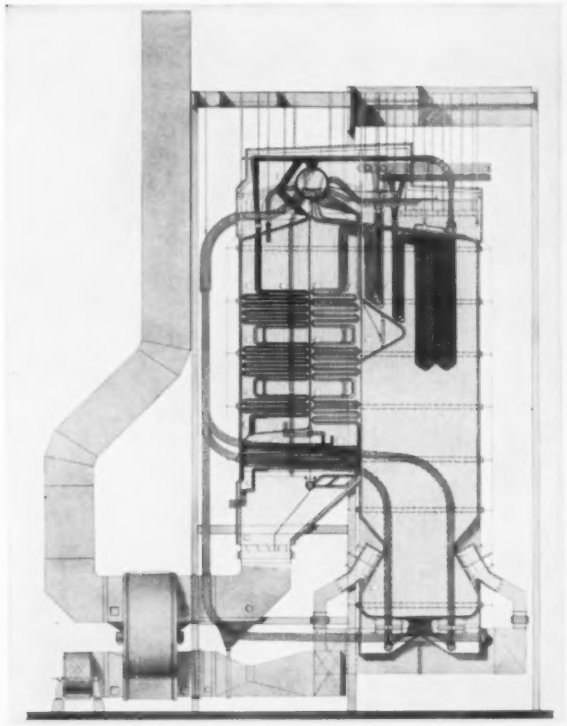
These graphs make it easy to figure unit generating cost if you know: (1) investment cost, dollars per kw (2) fixed charge rate, percent (3) plant annual use factor, percent (4) overall station heat rate, Btu per kwhr (5) fuel cost, cents per million Btu (6) number of men per mw capacity (7) average annual salary.

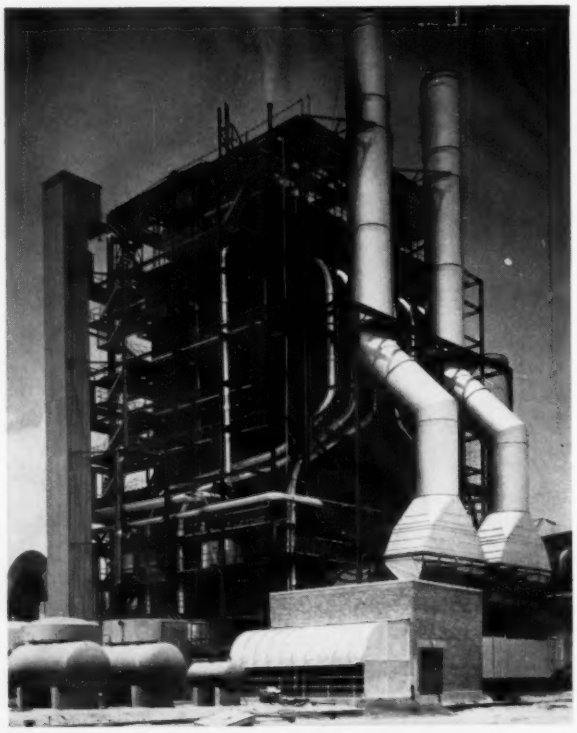
Example: A station has the following costs: $134 per kw; 14% fixed-charge rate; 80% use factor; 10,300 Btu per kwhr heat rate; 36c per million Btu fuel cost; 0.46 man per mw; and $6000 average annual salary.

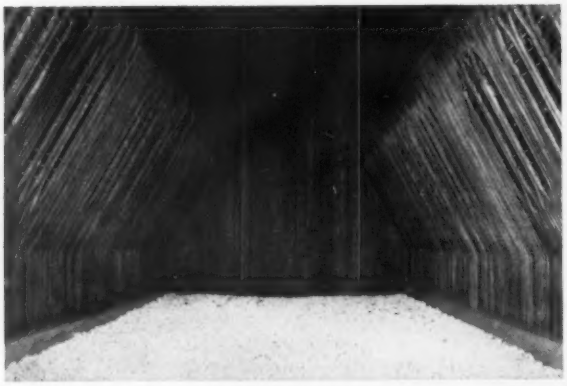
On graph, upper left, find $134 on left scale, following horizontally to 14% curve, turn up to 80% use factor, follow right to read 2.7 mills per kwhr. On graph, upper right, find 10,300 Btu per kwhr on horizontal scale, read up to 36c curve, follow left to read 3.7 mills per kwhr. On graph, lower left, find 0.46 man on vertical scale at left, follow right to $6000 curve, turn up to 80% use factor, follow right to read 0.4 mill per kwhr. Adding up: 2.7 + 3.7 + 0.4 = 6.8 mills per kwhr. To this, add cost of maintenance and supplies and you have total unit generating cost.

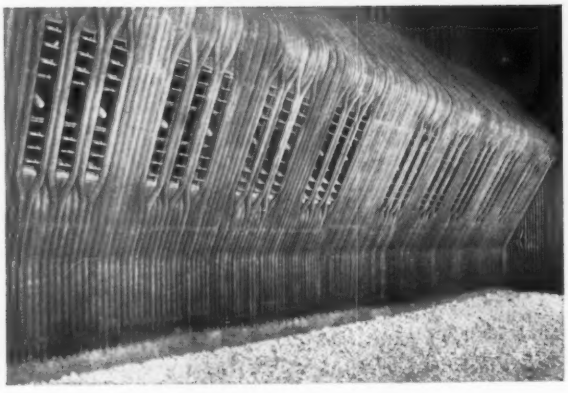
B G A Skrotzki, *Associate Editor*

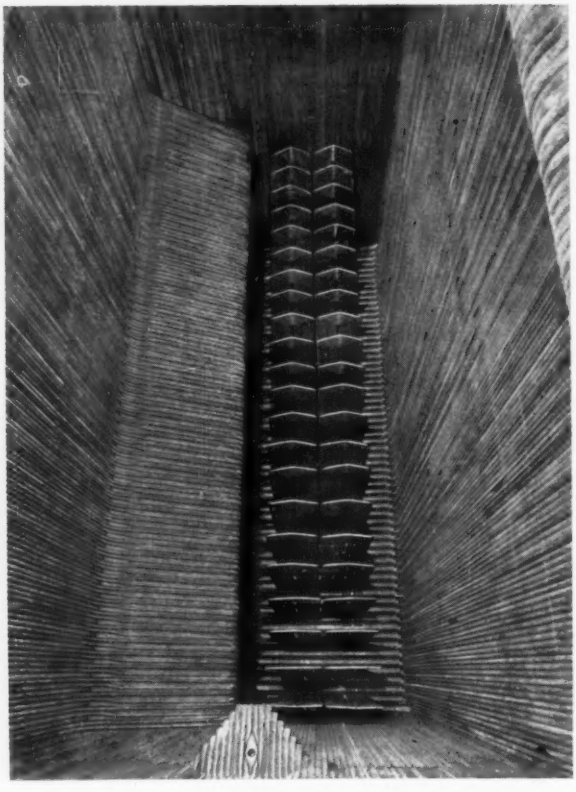
Performance









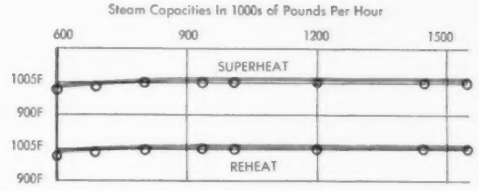


# of RILEY TURBO FURNACE Reheat Unit At Sterlington Steam Electric Station

Exceptional From Start-Up!

Unit Capacity — 1,550,000 lbs/hr
Pressure — 2175 Psig
Superheat and Reheat — 1005F

Wide Range of Steam Temperature Control

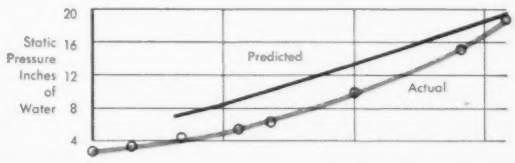


Low Air Heater Exit Gas Temperature

High Unit Efficiency

Low Forced Draft Fan Pressures

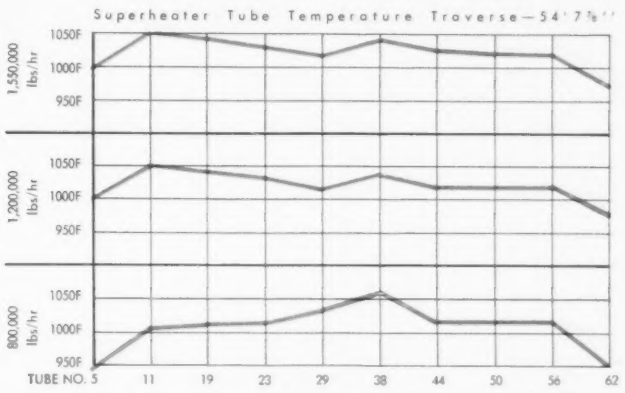
Low Auxiliary Power



Minimum Superheater Metal Temperature Variations Across 54 Ft. Wide Furnace

This results from the fact that the Riley Directional Flame Burners, arranged for opposed firing, produce uniform combustion across the entire 54′ 7⅞″ width of this Turbo Furnace which has no water cooled platens or divided walls. Gases rise evenly and vertically within the furnace envelope.

Views of Louisiana Power & Light Company's Riley Unit at Sterington illustrate the characteristic TURBO FURNACE bottom and some of the 20 Directional Flame Burners.



Curves Plotted From Readings Taken In Tests Conducted July 22, 1958

FOR TURBO FURNACE DETAILS — WRITE RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS

A survey of your plant by a qualified consulting engineer could show ways of making surprising savings in your power costs.

RILEY
STEAM GENERATING & FUEL BURNING EQUIPMENT

For more facts circle 842 on Reader Service Card p 222

"And for extreme pressure and temperature there is a heavy duty Armstrong"

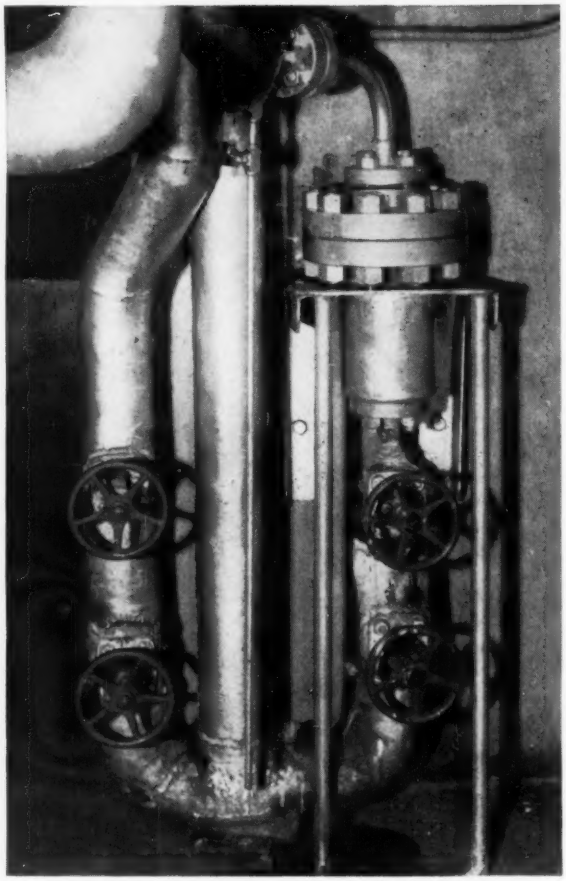
Reproduction of Armstrong Trap advertisement which appeared in power magazines in 1924.

Armstrong steam traps have grown up with the increase in steam pressure that started right after World War I. Forged carbon steel bodies made their debut in 1929 with carbon moly and chrome moly steels following as pressures went up.

The traps listed below have forged carbon steel bodies and caps for service to 600 psig, 750F.; carbon moly or chrome moly to 900 psig, 900F.; chrome moly to 2500 psig and temperatures above 900. Valves and seats heat treated chrome steel or Stellite. Other working parts are 18-8 stainless except the bucket weight.

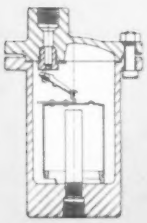
COMPLETE DATA in 44 page CATALOG J, free on request. Call your local Armstrong Factory Representative or write:

ARMSTRONG MACHINE WORKS
8121 Maple St., Three Rivers, Michigan

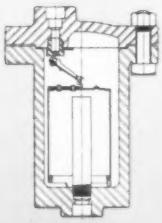


No. 515 Armstrong flanged trap at central station—dependable protection at superheated steam lines.

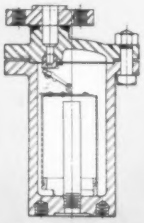
SCREWED, SOCKET WELD AND FLANGED CONNECTIONS



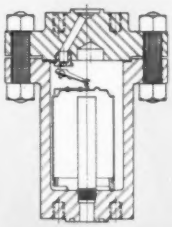
Screwed ½" to 2"—pressures to 900 lbs.



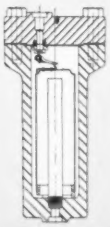
Socket weld ½" to 2" pressures to 900 lbs.



Flanged connections —½" to 2" pressures to 900 lbs.



No. 515 trap—socket weld or flanged 1" or 1¼"—pressures to 1500 lbs.



No. 615 trap—socket weld or flanged 1" or 1¼"—pressures to 2500 lbs.

ARMSTRONG INVERTED BUCKET FORGED STEEL **STEAM TRAPS**

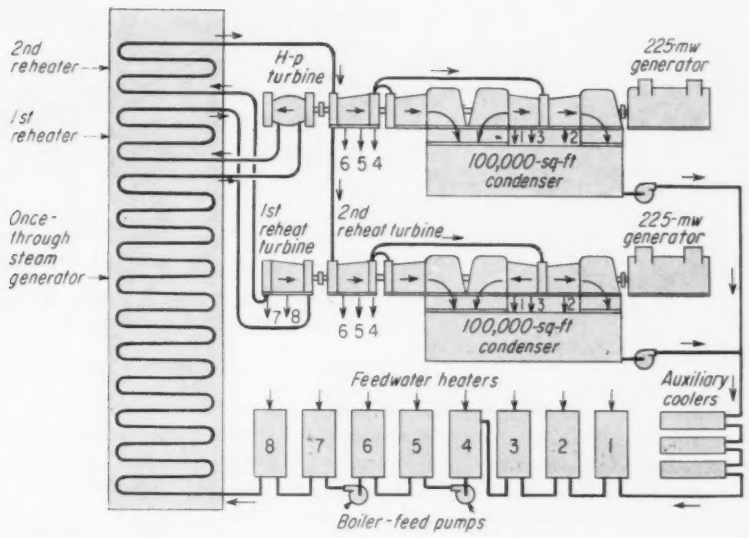
For more facts circle 843 on Reader Service Card p 222

PLAN '59

Power *reports on . . .*

Central station design

By B G A SKROTZKI, Associate Editor



ONCE-THROUGH CIRCUITS of superpressure plants promise new generating economies

Superpressure plants lead progress parade

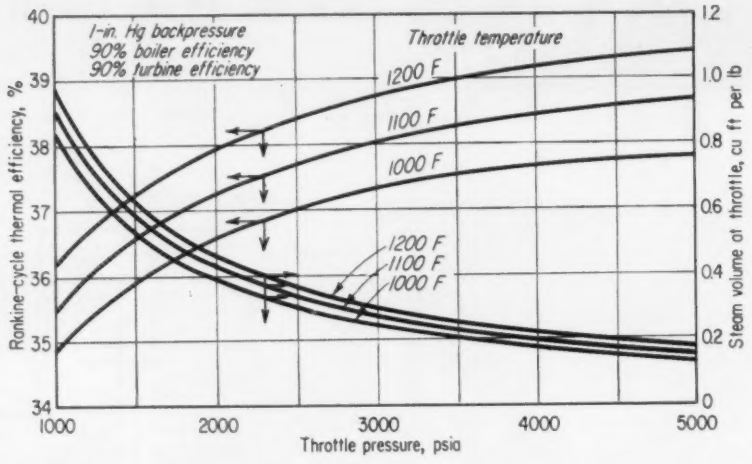
- Economic pressure, experience, ingenuity combine to push power-generating equipment into new areas using novel designs and anticipating new problems

- Right now the power industry awaits the critical evaluation of new equipment that only experience can give

- These pages can blaze a new trail in your thinking that will save a Btu here, a dollar there while keeping up with the ever-growing demand for power

Despite increased mechanization of fuel-producing methods, the long-term trend of fuel costs firmly staggers upwards. Since electric utilities must use fuels as their raw material, rising costs prompt them to seek methods of cutting fuel use to the economic minimum. This means developing power cycles with higher thermal efficiency and low incremental investment costs.

Leading designers have boldly invaded the domain of supercritical steam



RISING STEAM PRESSURES cause diminishing gain in simple Rankine-cycle thermal efficiency, reheating improves performance further. Volume shrinks at high pressures

conditions, above 3206.2 psia and 705.4 F. This raised new problems, but several years of research and development showed superpressure plants would be feasible. The first plant, Philo Unit 6, has over a year's experience and has vindicated the judgment of the utility pioneers. Table on facing page lists the principal features of the superpressure plants scheduled and building. Three groups have announced plants in the superpressure area: American Electric Power Corp, Philadelphia Electric Co and Cleveland Electric Illuminating Co.

Steam conditions. First step into superpressure was the experimental Philo-6 unit at 4500 psig, 1150/1050/1000 F with two reheats. Shortly thereafter plans for Eddystone-1 at 5000 psig, 1200/1050/1050 F were announced. After these two initial experimental steps, designers found it advisable to back off in pressure and temperature to 3500 psig, 1050/1050/1050 F, one of the four subsequent units having only one reheat.

The first two units were explorations into new territory. As the graph above shows, tempting gains in efficiency were promised by pushing up steam conditions to the limit. But steam volume shrinks, squeezing the first-stage steam blade height down to where friction and blade-tip leakage eats up the thermodynamic efficiency gain.

This can be offset by building large units needing high flows, by backing off in pressure, or by both. Keeping steam temperatures high also helps. The later units, as the table shows, have mitigated this leakage problem by both high capacity and lower pressure, 3500 psig. But to mitigate the material cost they have limited temperatures to 1050 F instead of staying at 1150 to 1200 F, making a sacrifice in theoretical thermal efficiency on the order of 1%.

Avon-8 evidently strives to minimize the complication of reheat by using only one stage compared to two for all the others. This indicates a loss of about 0.7% in thermal efficiency, as shown by the calculated plant heat rates, but apparently yields a net economic gain for the Cleveland system conditions.

Steam generator. Absence of boiling at supercritical steam conditions eliminates the possibility of using a natural-circulation boiler with its familiar massive drum. Once-through boilers using forced circulation are the only type that can be used—feedwater forced in at one end by the boiler-feed pump emerges as superheated steam at a lower pressure at the other end.

Once-through boilers have a long history of running at subcritical steam conditions. Most of these were built and run in Europe, and a limited number were built and operated for special purposes in the U.S. An intermediate form is the forced-circulation or La Mont boiler in which a pump draws water from a boiler drum and forces it through parallel boiler-tube circuits to be returned to the drum for separating steam and water.

Experience with subcritical once-through boilers showed the crucial importance of feedwater treatment and the advantage of placing the transition-zone tubing in the lower-temperature areas of the furnace. This minimizes potential overheating from possible solid deposition in the tubing.

Philo-6 had satisfactory water control experience as follows:

Item	*Specification*	*Actual*
Total solids	500 ppb	150 ppb
Silica	20 ppb	16 ppb
Iron	10 ppb	7 ppb
Copper	10 ppb	8 ppb
Dissolved O_2	5 ppb	3 ppb
pH	9.5—9.6	9.3—9.6

Specified values are maximums. Iron-oxide control was the most critical, but iron oxide can be regulated by mechanical filtration and chemical water treatment.

Turbine-generator. High pressures and temperatures involve extrapolation of sealing and cooling practices at the turbine front end to make a workable supercritical unit. No new design problems arise in the lower-pressure

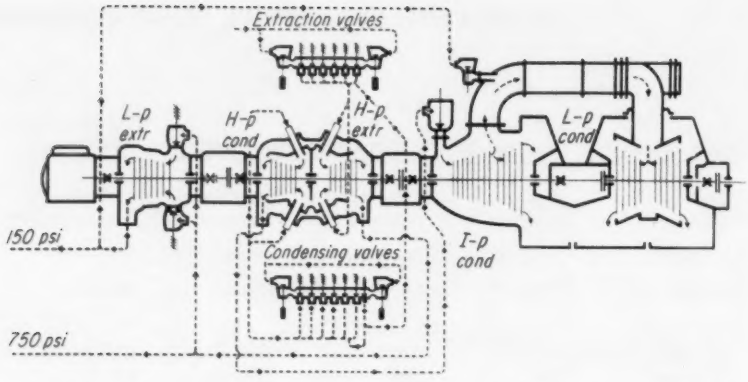
Supercritical-pressure plant equipment and data

Utility company	Ohio Power Co	Philadelphia Electric Company		Cleveland Electric Illuminating Co	Indiana & Michigan Electric Company	Ohio Power and Appalachian Electric Power Companies
Plant—Unit No.	Philo—6	Eddystone—1	Eddystone—2	Avon—8	Breed—1	Philip Sporn—5
Plant location	Philo, Ohio	Eddystone, Pa.	Eddystone, Pa.	Avon Lake, Ohio	Fairbanks, Ind.	New Haven, W. Va.
First operation	March 1957	December 1958	January 1960	Early 1959	July 1959	December 1959
Capability, kw	125,000	325,000	325,000	250,000	450,000	450,000
Pressure, psig:						
Throttle	4500	5000	3500	3500	3500	3500
1st reheat	1143	1028	936	645	1000	1000
2nd reheat	192	236	314	None	300	300
Temperature, F:						
Throttle	1150	1200	1050	1100	1050	1050
1st reheat	1050	1050	1050	1050	1050	1050
2nd reheat	1000	1050	1050	None	1050	1050
Boiler data:						
Manufacturer	Babcock & Wilcox	Combustion Engrg	Combustion Engrg	Combustion Engrg	Babcock & Wilcox	Babcock & Wilcox
Capacity, lb/hr	675,000	2,000,000	2,178,000	1,715,000	2,923,000	2,923,000
Furnace heat release-Btu/sq ft	—	87,000	89,000	85,700	—	—
Firing method	Cyclone furnace	Pulverized coal	Pulverized coal	Pulverized coal	Cyclone furnace	Pulverized coal
Furnace layout	Single	Twin	Twin	Twin	Single	Single
Furnace bottom	Slag tap	Dry bottom	Dry bottom	Dry bottom	Slag tap	Dry bottom
Air heater type	Tubular	Regenerative	Regenerative	Regenerative	Regenerative	Regenerative
F-d fans, drive	2 motor-driven	4 motor-driven	4 motor-driven	2 motor-driven	3 motor-driven	2 motor-driven
I-d fans, drive	2 motor-driven	4 motor-driven	4 motor-driven	2 motor-driven	None	None
Boiler-feed pumps	2 motor-driven	4 motor-driven 2 turbine-driven	4 motor-driven 2 turbine-driven	1 motor-driven 2 turbine-driven	2 motor-driven 1 turbine-driven	2 motor-driven 1 turbine-driven
Pump manufacturer	DeLaval Stm Turb	Ingersoll-Rand	Ingersoll-Rand	Worthington	Ingersoll-Rand	Ingersoll-Rand
Pump-heater system**	5H-P-2H-P	4H-P-5H-P-P*	4H-P-5H-P-P*	4H-P*-P*-4H[a]	5H-P-2H-P*-2H	5H-P-2H-P*-2H
Turbine builder	General Electric	Westinghouse	General Electric	Westinghouse	General Electric	General Electric
Turbine type	TC-2E	CC-2E	CC-6E	TC-3E	CC-6E	CC-6E
Turbine speed, rpm	3600	3600/1800	3600/3600	3600	3600/3600	3600/3600
No. bleed points	5	8	7	5	8	8
No. heaters	7	2 lines, 9 each	2 lines, 8 each	8[a]	9	9
Deaerating pressure, psia	210	54	76	118	48	48
Condenser sq ft	55,000	150,000	150,000	113,000	198,000	198,000
Condenser builder	Allis-Chalmers	Westinghouse	Westinghouse	Allis-Chalmers	Allis-Chalmers	Allis-Chalmers
High-temp piping	Type 347	Type 316	—	Type 316	Type P22	Type P22
Plant net heat rate, Btu/kwhr	8954	8016	8250	8603	8450	8450

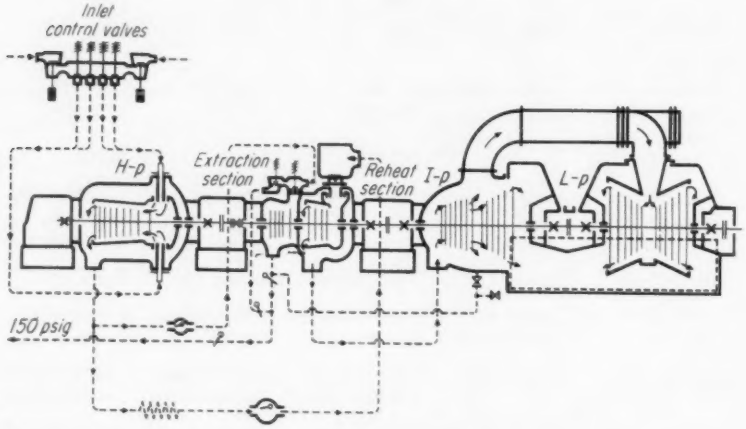
*—Turbine-driven pump **—Pump-heater system listed from condensate pump to boiler inlet a—two strings of 4 h-p heaters
CC—cross compound E—exhausts H—heater P—pump TC—tandem compound

end of the unit. All units have some form of shell cooling of the high-pressure turbine. Philo-6 uses rotor cooling with live steam to keep the blading and rotor below throttle temperature. Actual operation has conformed to the designer's expectations for these new conditions.

Unique arrangement for superpressure plants uses a bypass around the turbine from steam leads to condenser. To prevent overheating steam generator during starting, stopping and emergencies the water-steam working fluid must be kept moving, but not through the main turbines.



1 Unit No. 1 develops 225 mw on single shaft, has double-flow h-p turbine to handle record breaking 2,800,000-lb-per-hr throttle flow; steam extracted at 150 and 750 psig



2 Unit No. 2 also develops 225 mw, but has one stage of reheat to 1050 F and only one stage of extraction at 150 psig; reheat and extraction sections in common casing

Finding uses for bleed steam and its energy is the dream of every power-plant designer. This bonanza was found in the state of New Jersey, and is the reason why Public Service Electric and Gas Co's new plant . . .

LINDEN uses the world's largest automatic-extraction steam turbines

The Linden Station supplies the entire steam needs of the Bayway Refinery of the Esso Standard Oil Co in exchange for fuel and raw water. Esso supplies, at commercial rates, any additional fuel needed to generate full kw output. High-viscosity residual oil is the basic fuel supplemented by bunker-C fuel oil as needed.

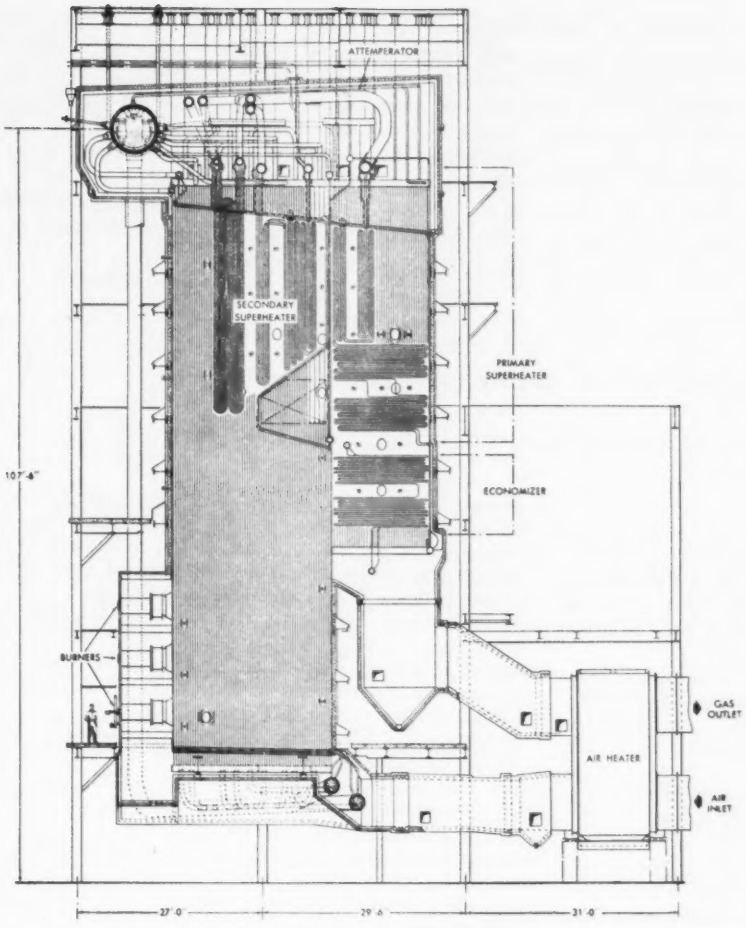
The generating station purifies, filters and demineralizes the raw water it receives from the refinery in exchange for steam. The refinery buys electric energy at regular wholesale rates from Public Service.

Steam supply. Three boilers supply 2000-psig 1050-F steam to Unit No. 1 which can produce 225-mw output, 400,000 lb per hr of 750-psig steam, and 750,000 lb per hr of 150-psig steam when receiving 2,800,000 lb per hr of throttle steam. Two boilers can supply full-load needs of the turbine, the third boiler insures availability of steam supply.

With this arrangement and two steam bypasses around the turbine the designers avoided (1) reheating complications and (2) using austenitic steel. This limited temperature to 1050 F. Extraction pressures fixed the throttle pressure.

Unit No. 2 also develops 225 mw with automatic extraction of 150-psig steam at 400,000 lb per hr, to allow for growing refinery needs. This turbine uses 1,820,000 lb per hr of 2350-psig 1100-F throttle steam supplied by one boiler that also reheats to 1050 F.

A 6300-ft run of pipe from Linden



3 Three boilers for Unit No. 1, similar to above, are built for pressure firing, have no i-d fans. These steam generators use platen superheaters and regenerative air heaters

to the refinery boilerhouse takes care of fluid interchanges. Two 30-in. lines carry l-p steam, two 16-in. lines carry h-p steam, an 8-in. line carries high-viscosity fuel, a 10-in. line carries bunker-C oil and a 16-in. line carries raw water with a 16-in. connection to Elizabethtown Water Co.

A central control room regulates all electric and steam operations in the plant with the exception of water treatment. This is regulated by a separate control system.

Fig. 3 shows one of the three radiant-type boilers for Unit No. 1. These boilers produce rated temperature at 65% load with spray attemperation for higher loads. The radiant platen superheaters maintain relatively constant steam temperature over a wide load range and reduce the gas temperature entering the convection section to minimize slagging.

The boiler for Unit No. 2 has pressure-fired twin furnaces, radiant platen superheater and reheater. One-half of the boiler has the h-t section of the superheater and the other half has the entire reheater. Both halves have l-t sections of the superheater. Gas recirculation controls the h-p steam temperature and differential firing controls temperature of the reheat steam.

Steam turbines. The full-load throttle flow of the 225-mw Unit No. 1, Fig. 1, corresponds to the flow for a 425-mw conventional reheat-regenerative unit. While total extraction is limited to 1,150,000 lb per hr, the 750-psig flow can rise to a top of 600,000 lb per hr and the 150 psig to 1,000,000 lb per hr, individually. At zero extraction, steam bypasses externally from the 150-psig point to the crossover entering the triple-flow l-p element.

The double-flow h-p element handles the unusually large throttle flow, the extraction-steam portion flowing toward the generator and the condenser-steam portion flowing toward the front standard. The 150-psig steam expands from the 750-psig extraction point in a separate casing at the front standard.

The double-flow h-p element has three advantages: (1) It brings the steam flow per wheel into a known range. (2) It avoids control valves for very-large-volume flows at the extraction pressures; control valves of the l-p extraction element pass a total flow of 1,000,000 lb per hr for 150 psig at a pressure of 750 psig. (3) Opposing steam flows minimize changes in total turbine thrust caused by variations in electrical and steam loads.

The last stages of the triple-flow exhaust turbines have 23-in. buckets. Turbines exhaust through side outlets into a twin-shell main condenser.

Fig. 2 shows the 225-mw unit No. 2, a 3600-rpm, tandem-compound, triple-exhaust-flow automatic-single-extraction turbine. With 1,820,000-lb-per-hr throttle flow it can produce 400,000-lb-per-hr steam at 150 psig. Exhaust from the h-p turbine splits, the extraction-steam portion going through the front end of the second casing; the larger condensing-steam portion goes to the reheater. The last stages of the turbine have 26-in. buck-

ets which exhaust through side outlets to a twin-shell main condenser.

Water treatment. Incoming raw water gets a primary treatment followed by demineralizing. Primary treatment chlorinates the raw water to the break point, chemically treats it for coagulation of impurities, allows it to settle and then filters it before delivering it to the demineralizers. System produces 3750 gpm of water that is essentially free of turbidity, color, oil and organic matter.

For demineralizing, the water flows through cation units for removing calcium, magnesium and sodium ions; through a vacuum degasser to remove O_2 and CO_2; through combination weak-base anion, strong-base anion units to remove sulfate, chloride and nitrate ions and silica; and finally through mixed-bed units containing cation and strong-base anion resins to remove trace impurities. The 12-ft diameter ion-exchange units are the largest ever built. Entire water-treatment system is automatic and can be run by two operators per shift.

Treated water will have a maximum of 0.2-ppm dissolved solids, 0.01-ppm dissolved silica, 0.02-ppm total silica and 0.5 micromhos conductivity.

Principal power-plant equipment

Units 1 & 2, Linden Generating Station, Linden, N. J., Public Service Electric & Gas Co

Turbine-generators and auxiliaries

Turbine-generators, 2 — General Electric Co
No. 1—225 mw, 2000 psig, 1050 F, 1.5 in. Hg, 3600 rpm, tandem-compound triple-flow double-automatic-extraction at 750 and 150 psig, steam sealed, 600 Mlb/hr h-p ext, 1000 Mlb/hr l-p ext, 6 bleed points, 3 phase, 60 cycle, 18 kv, 264,705 kva at 30-psig H_2 pressure, separately excited
No. 2—225 mw, 2350 psig, 1100/1050 F, 1.5 in. Hg, 3600 rpm, tandem-compound triple-flow, reheat, single-automatic extraction at 150 psig, 400 Mlb/hr ext, 8 bleed points, same generator specifications as No. 1, 3—1000 kw, 375 v, separate exciters for two generators

Condensers, 2 — Foster Wheeler Corp
No. 1—70,000 sq ft; *No. 2*—100,000 sq ft; *both*—Twin shell, single pass, inverted crossflow, side inlet, 15,000-gal storage hotwell

Condenser tubes — Revere Copper & Brass, Inc; Phelps Dodge Copper Products Corp
No. 18 Bwg, 7/8-in. OD, 30-ft long, arsenical aluminum brass

Circulating pumps, 4 — Foster Wheeler Corp
No. 1—50,000 gpm, 15-ft head, 252 rpm, 300-hp motor drive
No. 2—70,000 gpm, 16-ft head, 295 rpm, 400-hp motor drive; *both*—vertical, propeller type, wet pit

Traveling water screens, 2—55,000 gpm, 2—75,000 gpm — Chain Belt Co

Screen-wash pumps, 4 — Ingersoll-Rand Co
2—192 gpm, 2—247 gpm, vertical, 76-ft head, 15-hp motor drives

Vacuum pumps, 4 — Kinney Mfg Div of New York Air Brake Co
Rotating plunger, 780 cfm, 400 rpm, 40-hp motor drive

Turbine-oil conditioners, 3 — Bowser, Inc

Turbine-oil transfer pump, 1 — Turbine Equipment Co
Rotary, 40 gpm, 15-ft head, 1750 rpm, 3-hp motor drive

Feedwater system

Condensate pumps, 10 — Worthington Corp
No. 1, 4 primary and secondary, vertical, 1730 gpm, 350-ft head, 1150 rpm, 500-hp motor drives
No. 2, 3 primary, 2025 gpm, 90-ft head, 1150 rpm, 150-hp motor drive; 3 secondary, 2025 gpm, 566-ft head, 3570 rpm, 900-hp motor drives

Condensate coolers, 3 — Condenser Service & Engineering Co, Inc
No. 1, 2—5000 sq ft, 1,000,000 lb per hr. *No. 2*, 6250 sq ft, 1,300,000 lb per hr

Closed feedwater heaters, 13 — The Lummus Co
No. 1, 3 twin shell l-p, horizontal, 37,040 sq ft total; 2 twin shell h-p, vertical, channel down, 38,000 sq ft total
No. 2, 6 single shell, l-p (4 hor, 2 vert), 55,475 sq ft total; 2 single shell, h-p, vertical, channel down, 24,410 sq ft total

Deaerators, 2 — Worthington Corp
No. 1 only, horizontal, steam jet, 150 psig, 10,000-gal storage

Boiler-feed pumps, 11 — Worthington Corp
No. 1, 4 primary 1-stage, 1780 rpm, 4 secondary 4-stages, 8240 rpm, all 2381 gpm, 2414-ft head, 4500-hp motor drive
No. 2, 3 4-stages, 2381 gpm, 2247-ft head, 8400 rpm, 4500-hp motor

Boiler-feed pump stepup gears — De Laval Steam Turbine Co

Boiler-feed-pump hydraulic couplings, 7 — American Blower Corp
4500 hp, 1800 rpm

Boiler-feed pump oil coolers, 7 — Kewanee Boiler Div
385 sq ft each, 81 gpm, 170 to 120 F cooling

Heater drain pumps, 4 — Worthington Corp
No. 1, 2 vertical, 810 gpm, 43-ft head, 1170 rpm, 15-hp motor
No. 2, 2 vertical, 1200 gpm, 44-ft head, 1750 rpm, 20-hp motor

Pressure-reducing stations, 2 — General Electric Co
6 valves per station, 2000-psig 1050-F inlet steam. *No. 1*, 750-psig outlet steam, 500,000 lb per hr. *No. 2*, 150-psig outlet steam, 1,000,000 lb per hr

Desuperheating stations, 4 — The Swartwout Co
No. 1, 750-psig, 740-F outlet steam. *No. 2*, 150-psig, 462-F outlet steam

Reducing-station control — Leeds & Northrup Co

Steam-generating equipment

Boilers, 4 — Babcock & Wilcox Co
Pressurized furnaces, single drums, waterwalls
No. 1, 3 boilers, 1,000,000 lb per hr, 2147 psig, 1055 F, 44,750-cu-ft furnace volume, 12,516-sq-ft heating surface, 71,900-sq-ft superheating surface, 27,100-sq-ft economizer surface, 12 atomizing oil burners
No. 2, 1 boiler, 1,900,000 lb per hr, 2373 psig, 1100 F, 92,000-cu-ft furnace volume, 16,772-sq-ft heating surface, 172,542-sq-ft superheating surface, 20,900-sq-ft reheating surface, twin furnace, 61,800-sq-ft economizer, 24 oil burners, atomizing

Air heaters, 9 — The Air Preheater Corp
Ljungstron regenerative, horizontal shaft; *No. 1*, 6 heaters, 121,000 sq ft per heater; *No. 2*, 3 heaters, 157,100 sq ft each

Forced-draft fans, 8 — American Blower Corp
No. 1, 2 per boiler, 126,000 cfm at 100 F, 30.7-in. wg discharge, 700-hp 1800-rpm motor drive through fluid coupling
No. 2, 2 per boiler, 288,500 cfm at 100 F, 41.29 in. wg discharge, 2250-hp 1200-rpm motor drive through fluid coupling

Gas-recirculation fan, 2 — American Blower Corp
No. 2, 166,000 cfm at 675 F, 21.6 in. wg discharge, 800-hp 1200-rpm motor drive

Air soot blowers — Copes-Vulcan Div, Blaw-Knox Co
Automatic sequential, 250-psig air, *No. 1*, 18 retractable per boiler, 2 per heater; *No. 2*, 40 retractable, 3 for heaters

Fuel system—hi-vis and bunker C

Hi-vis oil heater, 2 — Alco Products, Inc
4580 sq ft, 600 gpm from 375 to 475 F, 750-psig 511-F steam
Low-pressure hi-vis pumps, 3 — De Laval Steam Turbine Co
Vertical rotary, 400 gpm, 50-ft head, 20-hp 1150-rpm motor drive
H-p hi-vis pumps, 8 — Byron Jackson Pumps, Inc, Subsidiary of Borg-Warner Corp
No. 1, 6 vertical, hydropress, centrifugal, 95 gpm, 1125-ft head, 200-hp 3600-rpm motor drive
No. 2, 2 vertical, hydropress, centrifugal, 200 gpm, 1125-ft head, 300-hp 3600-rpm motor drive
Hi-vis transfer pump, 1—65 gpm — De Laval Steam Turbine Co
Hi-vis reclaim, seal-oil, cleaning-station, drain pumps — Sier-Bath Gear & Pump Co
Fuel-oil heaters, 3—4740 sq ft — Alco Products, Inc
Fuel-oil tank heaters, 2—1330 sq ft — Griscom-Russell Co
H-p fuel-oil pumps, 5—210 gpm — De Laval Steam Turbine Co
L-p fuel-oil, reclaim, circulating pumps — Sier-Bath Gear & Pump Co

Compressed-air system

Air compressors, 3 — Clark Bros Co
Centrifugal, 2-case series, 7000 cfm, 350 psig, 9350 rpm, 3000 hp
Intercoolers, 3—829 sq ft — Kewanee Boiler Div
Aftercoolers, 3—554.4 sq ft — Griscom-Russell Co
Cooling-water pumps, 3—700 gpm — Allis-Chalmers Mfg Co
Soot-blowing air receivers, 2—1500 cu ft — The M W Kellogg Co
Station and control air receivers, 4—250 cu ft — Dover Tank & Stack Co
Control air dryers, 2 — Industrol Corp

Water-treatment system

Primary treatment plant, 2 units — Cochrane Corp
2 complete coagulation and filtration units, 3750 gpm total capacity
Tanks, 7 — Cochrane Corp
Water pumps, 9 — Worthington Corp
6000-gpm raw water, 3—3000-gpm filtered water, 2—8800-gpm backwash, 500-gpm backwash recovery, 2—225-gpm injector
Sludge-recirculating pump, 250 gpm — Aurora Pump Co
Carbon transfer pump, 40 gpm — La Bour Co, Inc
Chemical feeders, 6 — B-I-F Industries, Inc
Chemical mixing agitators, 5 — Mixing Equipment Co
Demineralizing plant, 3200 gpm — Cochrane Corp
7 cation, 6 combination anion, 5 mixed-bed units
Vacuum degasser — Cochrane Corp
Pumps, 8 — Worthington Corp
3—2350-gpm degasser, 57-gpm caustic reclaim, 90-gpm brine, 100-gpm cleaning solution, 30-gpm chemical waste, 100-gpm resin handling
Degasser vacuum pumps, 3 — Kinney Mfg Div, New York Air Brake Co
Acid feed pumps, 2; caustic feed pumps, 2 — Taber Pump Co
Chemical tanks, 8 — Cochrane Corp
Chlorination equipment — Wallace and Tiernan, Inc
Chemical pumps, h-p, cleaning — Worthington Corp
Feed pumps, 10 — Lapp Insulator Co, Inc
4 continuous chemical feed, 6 ammonia and hydrazine feed
Measuring pumps, 2 — Chempump Corp

Piping

Main steam, reheat steam and h-p boiler feed — The M W Kellogg Co
Condensate — Cornell & Underhill, Inc
Bleed steam and heater drain — Midwest Piping Co, Inc
Intermediate and l-p steam — Midwest Piping Co, Inc; Cornell & Underhill, Inc
Circulating water — Lock Joint Pipe Co
Miscellaneous — National Tube Co; Republic Steel Corp; Taylor Forge & Pipe Works; Spang-Chalfant Div; Warren Foundry & Pipe; Lock Joint Pipe Co; Raybestos-Manhattan, Inc; Herman Goldner Co

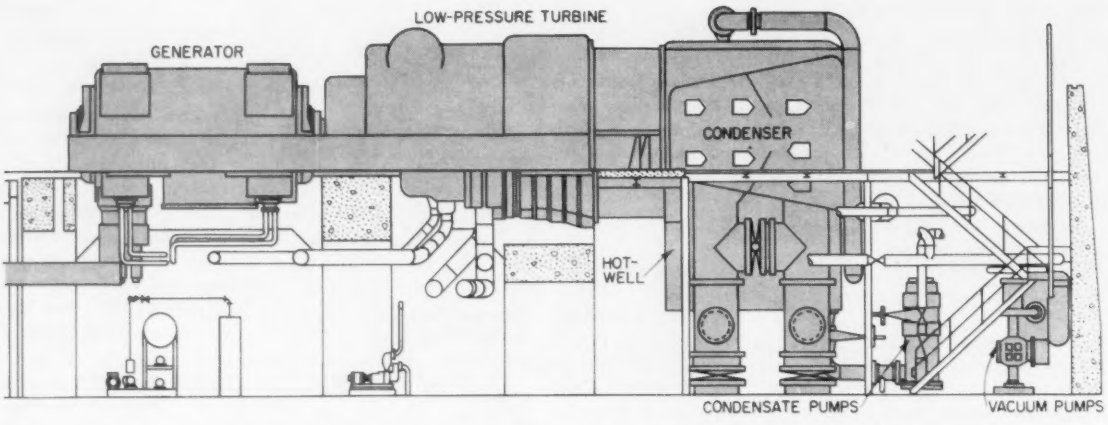
Strainers — Andale Co; Leslie Co
Hangers — Grinnell Corp; Bergen Pipe Support Co; Piping Specialties, Inc
Rubber expansion joints — Moisson Packing & Rubber Co; United States Rubber Co
Metal expansion joints — Badger Mfg Co
Steel gate, globe, check valves — Edward Valves, Inc; The Wm Powell Co; Chapman Valve Mfg Co; Crane Co; Manning, Maxwell & Moore, Inc
Valve operators — Philadelphia Gear Works
Bronze valves — Lunkenheimer Co
Iron valves — Walworth Co
Safety valves — Manning, Maxwell & Moore, Inc; Foster Engineering Co
Relief valves — Crosby Steam Gage & Valve Co; Manning, Maxwell & Moore, Inc; Farris Engineering Corp
Regulating valves — Fisher Governor Co; Bailey Meter Co; The Swartwout Co
Bleeder check valves — Gimpel Machine Works, Inc
Miscellaneous valves — Rockwell Mfg Co; Henry Pratt Co; The A P Smith Mfg Co; Lunkenheimer Co; Fisher Governor Co

Instruments and controls

Combustion and steam-temperature control systems — Leeds & Northrup Co
Feedwater flow control, pressure transmission, flowmeters — Bailey Meter Co
Flue-gas oxygen and multipoint temperature recorders — Leeds & Northrup Co
Single-point temperature recorders — The Swartwout Co
Boiler-feed pump recirculation control — Republic Flow Meters Co
Traveling-screen differential control — Foxboro Co
Miniature pneumatic recorders — Taylor Instruments Cos
Miniature electronic recorders — The Swartwout Co
Bunker-C fuel-oil meters — R N Brodie Co
Hi-vis fuel-oil meters — Fischer & Porter Co
Condensate-cooler temperature, air compressor controls — Hagan Corp
Thermowells — Trinity Equipment Corp
Sample-cooling coils — Parker Appliance Co
Feedwater-heater drain level controls — Fisher Governor Co
Fuel-oil pump pressure controls — Fisher Governor Co
Cabled copper control air tubing — Crescent Insulated Wire & Cable Co
Fuel-oil temperature control — Republic Flow Meters Co
Control panels — Falstrom Co

Miscellaneous pumps and equipment

Salt-water-service pumps, 2—4000 gpm — Worthington Corp
Sump pumps, 6—300 gpm, 5—100 gpm — James P Cannon Co
Flood pump, 1—5000 gpm — Turbine Equipment Co
Fire pump, 1—1600 gpm — Goulds Pumps, Inc
Fire-pump engine drive, 1—100 hp — Continental Motors Corp
Service-water pump, 1—160 gpm — Worthington Corp
Boilerhouse elevators, 2—200 fpm — Otis Elevator Co
Service-building elevators, 2—100 fpm — Otis Elevator Co
Turbine-room crane, 200 ton; Air-heater crane — Manning, Maxwell & Moore, Inc
Ventilating equipment — Buensod-Stacey, Inc
Fire-protection equipment — American LaFrance Corp; Couse & Bolten Co; The A P Smith Mfg Co
Safety equipment — Mine Safety Appliances Co



1 Low-pressure element of close-coupled cross-compound 150-mw turbine-generator has a single-flow axial-exhaust l-p turbine. Diffusing exhaust hood connects turbine to condenser on main operating floor keeping the basement head room lower than usual

PORTLAND keeps abreast of advanced plant design

Though superpressure would not pay, this plant found new ways to hold down both investment and operating costs by using monotube boiler, axial exhaust turbine and side-entry main surface condenser on turbine floor

Metropolitan Edison Co has just put Unit No. 1 into service at their Portland Station, near Portland, Pa. Comparative studies of steam conditions ranging up to 3500 psig and 1050/1050 F for this 150-mw unit led to choosing 2400 psig and 1050/1050 F. The lower steam conditions proved more economical for the capacity. The 1050-F temperature avoids using costly austenitic piping and breaks even economically with 1000 F at present fuel costs.

This unit, marked by outstanding pioneering design features, has an anticipated capability of about 165 mw. With the turbine valves wide open, full capability will be developed by raising steam pressure to 2520 psig. Rated 2400 psig, however, gives better thermal efficiency.

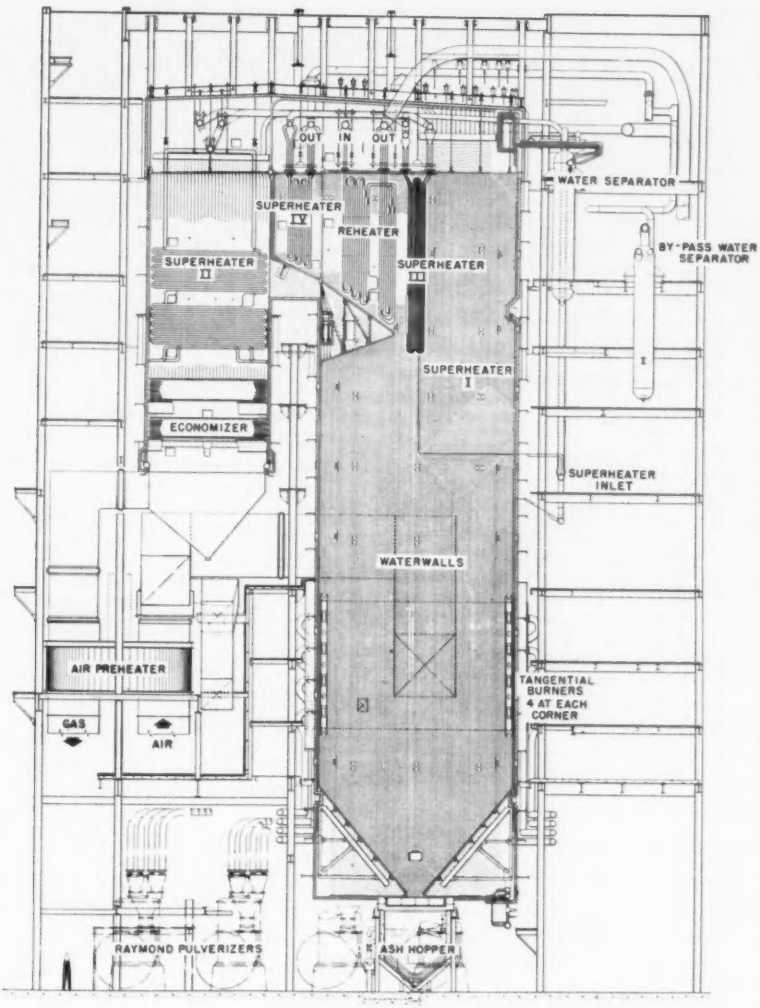
Steam generator. The once-through or monotube boiler needed for supercritical cycles offers strong operating advantages for lower pressures. The generator has a furnace heat release of 89,000 Btu per hr per sq ft at an output of 1.15 million lb per hr. Instead of a massive steam drum the unit has three smaller pressure vessels—two water separators and a bypass separator—that can be placed anywhere. Thin-walled pressure parts avoid building up thermal stresses and allow greater operating flexibility.

The water-steam side of the monotube generator has two halves with separate controls. The boiling section of each half divides into six circuits of nine 1½-in. OD tubes, Fig. 2. Special sleeve type throttling valves control the flow to each circuit. Each half has its own separator between boiling section and primary superheater. Solids concentrate in the separators. About 4% of the total flow bleeds back into the cycle through the h-p and deaerating heaters, Fig. 3.

Two pressure-difference and two flow-regulating valves control water flow to the unit. The flow-regulating valves get their operating impulses from one thermostat on steam-generating tubes' outlet and a steam-flow orifice after the water separator.

Any one tube in each circuit can be designated as the control tube since all have a throttling valve at inlet and thermostat at outlet. Only one tube in each circuit acts as control with the throttling valves adjusted to give this tube 50-F superheated output steam while the others produce wet steam with 4% moisture.

Tilting burners and spray desuperheaters control outlet steam temperature. The radiant superheaters, Fig. 2, give flat temperature control over a wide range of steam flow. The monotube boiler can be raised to full



2 Monotube steam generator has two water-steam sections in parallel. Each section has water separator between boiling and superheating tube circuits to control solids

pressure and temperature in less than one hour aided by the bypass used for starting. This feature also eases the problem of matching temperatures of steam and turbine metal after short shutdowns.

The boiler passes a minimum of about 30% full flow through the evaporating section during startup. About 10 to 30% full flow through superheater and reheater establishes needed steam temperature. The bypass separator discharges steam to the reheater and water to the condenser hotwell. When pressures and temperatures are properly established the bypass closes as the turbine valves open during the warming operation. During emergency load dumps, the bypass opens to maintain water circulation through the monotube steam generator.

Turbine-generator. The close-coupled cross-compound unit has a single-cylinder low-pressure turbine with an axial exhaust. Fig. 1 shows the arrangement of the 1800-rpm l-p element with its side-entry condenser on the main operating floor. This floor stands 13 ft below boiler-operating floor and 8 ft below the grade outside of the building.

Condenser height above normal water level controlled the operating floor elevation. Turbine elevation of 21 ft above basement level represents considerable reduction when compared to conventional arrangements.

The 3600-rpm h-p element of the 150-mw unit has both a high-pressure and intermediate-pressure section. The 2400-psig 1050-F steam enters at midsection through four control valves on the shell, flows through four nozzle boxes, expands toward the generator through eight stages and exhausts to the reheater at about 545 psig and 670 F. Reheated steam passes through the reheat stop valves and intercept valves to re-enter the midsection of the shell and expand toward the turbine front through five stages to exhaust upward to a single 36-in. crossover.

Steam enters the inboard end of the l-p turbine from the crossover at top to expand through ten stages and the axial-exhaust hood to the condenser. The top crossover relieves congestion below the floor and avoids cutouts in the foundation's beams.

The unique axial-flow exhaust hood has struts supporting an internal housing containing journal bearing, shaft seals, emergency governor and other l-p turbine controls. The exhaust hood has a diffusing section to recover some of the kinetic energy in the steam leaving the last-row buckets. This is done by keeping a lower pressure at the bucket outlets than in the condenser. The diffuser slows the steam while raising its pressure; this raises turbine efficiency. Eliminating friction losses of a conventional vertical exhaust plus energy recovery leads turbine designers to expect about 0.2 to 0.4% improvement in turbine heat rate.

Main condenser. The side-entry condenser has an 80,000-sq-ft surface, divided waterbox and single-pass arrangement. To minimize leakage that would be intolerable for the monotube boiler, the admiralty-metal tubes are welded to the silicon-bronze tube sheets of the condensers.

To establish uniform flow through the diffusing exhaust hood the center of condensation should coincide with the condenser tube bundles' center. This is done by making the two tube bundles single flow in opposing directions. During cold-water seasons the condenser can run as two pass with a single circulating pump. Fig. 1 indicates that the tube bundles have

a blunt arrow-shaped layout aimed into the exhaust steam flow.

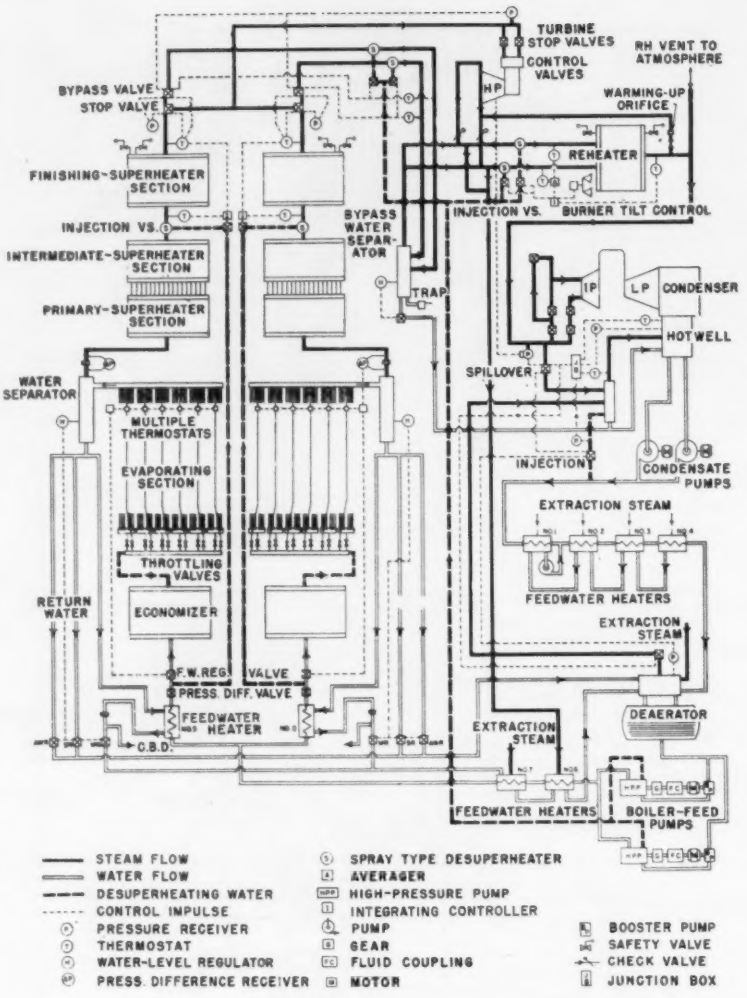
The 16,000-gal deaerating hotwell can carry full load for ten minutes. The hotwell receives the starting and emergency dump steam after being throttled from the steam mains. Spray nozzles cool the 65-psig steam before it expands into the tube bundle for condensation.

Two 49,000-gpm vertical-shaft single-stage circulating pumps in the screen house discharge to 72-in. concrete pipes. Condenser discharge leaves through a 72-in. concrete pipe leading to a common discharge tunnel with an outfall to the river. Six butterfly valves permit backwashing the condenser. These proved cheaper than two specially designed backwash valves and also reduce the pumping costs.

Combustion control. Two methods can be used to automatically control combustion: (1) conventional and (2) direct energy balance. Conventional method has the turbine governor regulate the inlet valves to control generator output while variation in steam pressure controls furnace energy input. Generator output variation plus regulation applied to turbine-governor motor can be used as a combustion-rate anticipator.

In the direct energy balance method the change in generator frequency controls fuel input to the furnace while generator output controls the air input. The turbine governor acts to keep constant steam pressure. Direct control of energy input to the furnace gives the needed generator output and the turbine keeps in step with the steam-generator output.

A transfer switch in the electrical combustion control system will let the operator use either method. The designers expect the relatively untried direct energy balance method to be used mostly.



Control system of monotube boiler and reheat turbine includes steam bypass for maintaining flow through boiler during startups and emergency turbine shutdowns

Feedwater heating. Of the eight feedwater heaters, seven are fed by steam bled from the turbine. The highest-temperature heater, No. 8, cools the drains from the steam-generator water separators. This drain cooler, Fig. 3, reduces the flashing head of water entering heater No. 7 and also reduces cost of this heater and gives a slightly better cycle efficiency for the overall plant.

Feedwater deaerates in both the condenser hotwell and the 165-psig deaerating heater. This heater runs at the upper limit of present-day practice. The savings realized by eliminating one closed h-p heater more than offset the cost of the higher-pressure deaerator. This arrangement offers advantages of less need of h-p heater maintenance, and keeping positive deaerating pressure over a wider range of loads.

All the closed heaters have drain-cooler sections with the exception of No. 1. They are all vertical type heaters with welded shell joints. No. 6, 7 and 8 have seal-welded heads and tubes welded to the tube sheets. They use monel-metal tubes while the l-p heaters have admiralty tubes.

Two half-capacity pumps serve the feedwater systems with no spare. The combination pumps consist of an 1800-rpm booster pump directly connected to the motor drive and a 6800-rpm pump driven through a hydraulic coupling and stepup gear. The booster pump allows using a lower npsh and lower deaerating heater elevation. The high-speed pump permits fewer stages and shorter and more rigid shaft than a 3600-rpm pump. The designers expect the high-speed pump to be more reliable. If experience indicates the need of a spare half-capacity pump, room has been allowed for its installation at a later date.

Principal power-plant equipment

Portland Power Station, Unit No. 1, Portland, Pa., Metropolitan Edison Co

Steam-generating equipment

Steam generator, 1 — Combustion Engineering, Inc
1,150,000 lb per hr, 2610-psig 1060-F superheater outlet, 1060-F reheat, 20,300-sq-ft waterwall surface, monotube type; two flow systems each with 25,500-sq-ft economizer, waterwall, boiler-water separator, radiant superheater, convection superheater, platen-convection superheater; independently controlled valves for: (a) feedwater flow (b) boiler-feed-pump speed (c) blowdown and water return from separator (c) spray water for superheat control

Separators, 3 — Combustion Engineering, Inc
Two for boiler water at 2930 psig, 30-in. ID x 24-ft high. One by-pass separator at 750 psig, 36-in. ID x 25-ft high

Desuperheaters, 6 spray type — Combustion Engineering, Inc

Reheat steam temperature control — Leeds & Northrup Co

Automatic control — Sulzer Brothers, Ltd

Air heaters, 2 — The Air Preheater Corp
Ljungstrom regenerative, vertical inverted, 104,700 sq ft

Automatic damper control — Automatic Temperature Control Co

Pulverizers, 4 — Combustion Engineering, Inc
Bowl mills, 36,600 lb per hr, 70% thru 200 mesh, 55 Hardgrove

Soot blowers — Copes-Vulcan Div, Blaw Knox Co
Superheater and reheater: 16 long retractable, 10 wall boxes (future); economizer, 10 wall boxes (future); furnace, 48 wall blowers, 20 wall boxes (future); air heaters, 2 sets

F-d fans, 2 — Sturtevant Div, Westinghouse Electric Corp
209,000 cfm, 100 F, 16-in. water, 885 rpm, 612 bhp

I-D fans, 2 — Sturtevant Div, Westinghouse Electric Corp
292,000 cfm, 266 F, 19 in. water, 880 rpm, 1032 bhp

Dust collector, 1 combined — Buell Engineering Co, Inc
584,000 cfm, 266 F, 1st-stage cyclones, 2nd-stage electrostatic precipitator, two parallel sections for independent operation

Chimney, 1 — The Rust Engineering Co
Tapered, reinforced concrete, 400-ft high, 9-ft 4-in. internal top dia, acidproof shale brick lining

F-d fan steam coils, 2 — American Blower Corp
Heat 631,000-cfm air from 15 to 93 F with 565-psig 681-F steam

Feedwater heating system

Deaerating heater, 1 — American Water Softener Co
1,200,000 lb per hr, 200-psig design pressure, max O_2 of 0.005 ppm, 25,000-gal storage

Boiler-feed pumps, 2 — Worthington Corp
658,000 lb per hr, 363 F, 263-psig suction, 3570-psig discharge, 6800 rpm, 76% pump efficiency, 3838 bhp

Speed-increasing gear, 2 — Westinghouse Electric Corp

Hydraulic couplings, 2 — American Blower Corp

Booster pumps, 2 — Worthington Corp
737,000 lb per hr, 167.5 to 263 psig, 1750 rpm, 115 bhp, 81% efficiency

Closed feedwater heaters, 6 — Griscom-Russell Co
Vertical, *No. 7*, 4190 sq ft, desupht and subcool; *No. 6*, 7410 sq ft, desupht and subcool; *No. 4*, 3761 sq ft, desupht and subcool, *No. 3*, 2838 sq ft, subcool, *No. 2*, 3899 sq ft, subcool, *No. 1*, 3125 sq ft

Heat exchangers, 3 — Griscom-Russell Co
1 1-p, 3810 sq ft; 2 h-p 435-sq-ft cooling separator drains

Evaporator, 1 — Griscom-Russell Co
Single-effect bent tube, 9000 lb per hr

Evaporator preheater, 1 — Graver Water Conditioning Co

Condensate transfer pump, 1 — Allis-Chalmers Mfg Co

Heater recirculation pumps, 3 — Worthington Corp

Heater drip pumps, 2 — Worthington Corp

Boiler-feed pump injection water return system — Aurora Pump Co

Miscellaneous drip unit, 1 — Aurora Pump Co

Turbine-generator and auxiliaries

Turbine-generator unit, 1 — General Electric Co
150 mw, cross-compound, single flow, axial exhaust, 2400 psig, 1050/1050 F, 3.5-in. Hg, 3600-rpm h-p element, 1800-rpm l-p element, 1,025,000 lb per hr; 13.8-kv H_2-cooled 0.85-pf gen

Exciters, 3 — General Electric Co
300 kw, 1200 rpm, 4-pole, 250 v, motor driven

Turbine-oil systems — Bowser, Inc

Main condenser, 1 — Ingersoll-Rand Co
Horizontal, single pass, 80,000 sq ft, silicon-bronze tube sheets, 718,000 lb per hr, 1-in. Hg pressure, 54-F cooling water, 95,000 gpm, 6.66 ft per sec, reheating-deaerating hotwell

Condensate pumps, 2 — Ingersoll-Rand Co
Vertical, 7 stages, 1625 gpm, 675-ft total head, 358 bhp

Circulating-water pumps, 2 — Ingersoll-Rand Co
Vertical, volute type, single stage, 49,000 gpm, 35.5-ft head, 86% efficiency, 512 bhp, 270 rpm

Dry vacuum pumps, 2 — Ingersoll-Rand Co
Horizontal opposed, 2 cylinder, double acting, reciprocating, driven by 75-hp 440-v motors

Traveling-water screens, 2 — Chain Belt Co

Condenser tubes, 14,000 — Revere Copper and Brass, Inc
Arsenical inhibited admiralty, ¾-in. OD, 18 Bwg, 30 ft

Condenser-waterbox vacuum pump, 1 — Nash Engineering Co

Circulating-water syphon vacuum pumps, 2 — Nash Engineering Co

Miscellaneous equipment

Rotary railroad car dumper, 1 — Heyl and Patterson, Inc

Coal-handling equipment — Link-Belt Co
2 inclined apron feeders, 450 tph each, 6 belt conveyors, 390-ft tripper belt conveyor, 110-ft boom type traversing stacker belt conveyor, 16 reclaim hoppers, 8 chutes and flop gates, 16 vibratory feeders, 1 magnetic separator, 2 belt scales

Bradford breaker, 1 — Pennsylvania Crusher Div

Coal crusher, 1 — Pennsylvania Crusher Div

Diesel hydraulic locomotive, 1, 310 hp — Plymouth Locomotive Works

Caterpillar tractor, 1 — Giles & Ransome, Inc

Coal-handling dust-control system — The Johnson-March Corp

Coal-thawing pit equipment — Hauck Mfg Co

Coal-sample crusher — American Pulverizer Co

Ash-, dust, pyrites-handling system — The Allen-Sherman-Hoff Co

Ash water pumps, 3 — Ingersoll-Rand Co

Automatic sodium-zeolite water softener, 1 — The Permutit Co

Chlorinating system, 1 — Fischer & Porter Co

Soot-blowing air compressors, 3 — Ingersoll-Rand Co

Combustion control system — Leeds and Northrup Co

Boiler-feed pump recirculation control — Bailey Meter Co

Hollow forged pipe — Babcock & Wilcox Co

Butterfly valves, 8 — Henry Pratt Co

Piping and fittings — Black, Sivalls & Bryson, Inc; Schutte & Koerting Co; Ladish Co; Benjamin F Shaw Co; Andale Co

Level controls — Fisher Governor Co

Relief, safety valves — Manning, Maxwell & Moore, Inc

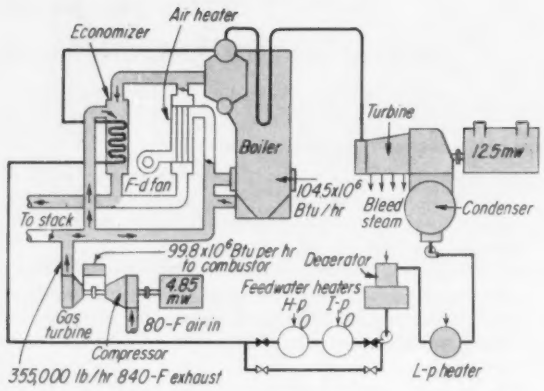
Globe and gate valves — Crane Co; Kennedy Valve Mfg Co

Check valves — Edward Valves, Inc

Motor drives — Westinghouse Electric Corp

Engineers — Gilbert Associates, Inc

Over 100 gas-turbine units with more than 450,000-kw capacity work from day-to-day in the U.S.A. About 25 units totaling almost 150,000 kw serve our electric utilities; 57 units totaling more than 300,000 hp power gas pipelines. About 20 units do various jobs in industry. Their versatility establishes a landmark when . . .



1 Warwick station teams up 5-mw gas turbine and 12.5-mw steam turbine. For combined operation gas-turbine exhaust feeds air to boiler and economizer; air heater, h-p, l-p heaters are off

Gas turbines team up with steam

Gas turbines are fulfilling all the jobs predicted for them about a decade ago. They serve peak-load, end-of-transmission-line, base load, standby, feedwater-heating and combined gas-steam cycle duties. The first gas turbine to start in utility service was at the Belle Isle Station of the Oklahoma Gas and Electric Co; its exhaust heated feedwater and allowed the steam turbines to develop more capacity with a limited boiler steaming capacity.

Hot-exhaust combined cycle. Latest gas turbine to go into service works with a steam turbine and boiler at the Warwick Station of the Crisp County Commission of Georgia, Fig. 1, 2 and 3. Exhaust gas of a 5-mw gas-turbine unit (gas-fired) supplies heated combustion O_2 to a 130,000-lb-per-hr 625-psig 825-F steam generator. The steam drives a 12.5-mw 3600-rpm regenerative condensing turbine-generator with four bleed points. The boiler furnace may be fired with natural gas, oil or pulverized coal in combination with the gas-turbine exhaust or with atmospheric air.

Gas-turbine exhaust contains about 16% O_2 which acts as preheated air for the furnace. Part of the exhaust, tempered with room air, serves as pulverizer primary air, not shown in Fig. 1. A second part enters the burner windbox to serve as secondary air. A third part enters through the furnace hopper to control steam temperatures down to 90,000 lb per hr. A fourth part joins the boiler-outlet gas to flow through the economizer.

The boiler furnace runs pressurized so that no i-d fan is needed. Fig. 1 shows the air heater is isolated from the gas cycle when the gas turbine runs. The last two feedwater heaters are bypassed to increase the heat recovery in the economizer.

Isolated cycle. Fig. 2 shows the cycle with the gas turbine out of service. The f-d fan pushes air into the furnace through the air heater. Gas pass of the economizer is isolated from the cycle. The h-p and i-p feedwater heaters are put into service to maintain high cycle efficiency since economizer does no heat-recovery duty.

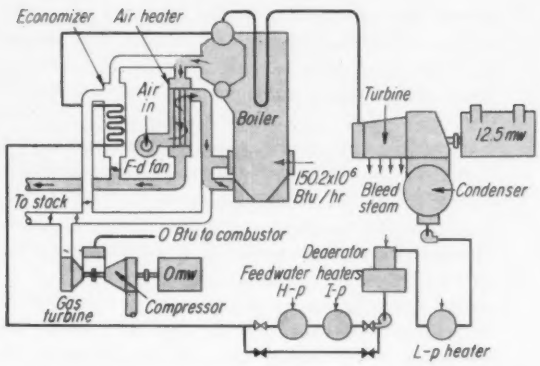
The h-p and i-p closed-heater drains cascade back to the deaerating heater and the l-p closed-heater drains cascade to the condenser hotwell.

Entire unit stands outdoors and comprises part of a hydroelectric plant. Part of the year the unit serves peak-load duty; the remainder of the year it runs on base load when river water runs low. Both hydro station and thermal unit will run under one supervisor.

The steam generator was built by Babcock and Wilcox Co and has two pulverizers. Steam and gas turbines were built by General Electric Co. The steam turbine runs at 3600 rpm with a 2-in.-Hg backpressure and is guaranteed at 8.93-lb-per-kwhr steam rate. The gas turbine is a 5-mw single-shaft simple-cycle unit turning at 6900 rpm. It drives the 6250-kva generator through a reduction gear at 3600 rpm. The steam turbine exhausts into a 10,000-sq-ft dual-bank surface condenser built by C H Wheeler Manufacturing Co.

Gas-turbine supercharging. Cycles using a common pressurized furnace for both a steam generator and a gas turbine have been studied intensively, but so far none have been constructed. The Velox boiler has used the basic idea for many years, but the gas turbine merely drives the compressor to supercharge the boiler furnace. The prevailing proposals, Fig. 4, extend this idea to producing excess power at the turbine shaft to carry loads in parallel with a steam turbine fed by the boiler.

The steam cycle may use any steam conditions that prove economical. The combined cycle has a lower heat rate than a comparable conventional steam cycle and the



2 Warwick station can run with steam cycle alone by isolating economizer from boiler exhaust, pushing air through air heater with a f-d fan. H-p and l-p feedwater heaters are running

turbines for economy

overall investment costs are about equal. The pressurized combustion gases step up heat-transfer rates to as high as 200,000 Btu per hr per sq ft compared to the conventional 85,000 for atmospheric furnaces.

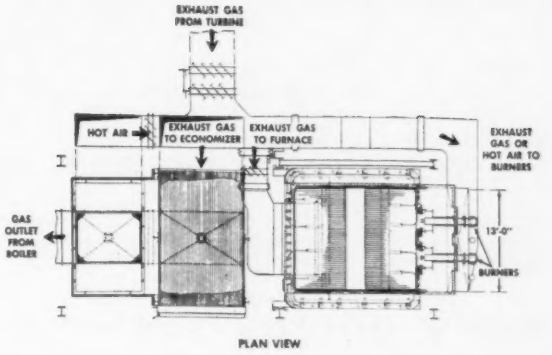
This pays off in a smaller, compact steam generator. Capital savings on the smaller boiler usually pay for the gas-turbine unit and leave the fuel saving as a net overall gain according to studies made.

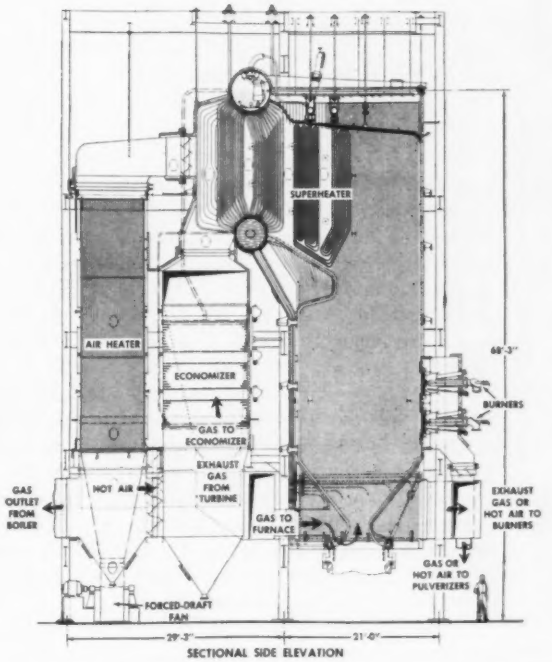
Fig. 4 shows a suggested cycle for a 45-mw combination plant. A 6-mw, 2-shaft, simple-cycle gas-turbine unit supplies 71-psig 500-F air to the boiler furnace and receives 69-psig 1450-F power gas in return. The gas passes through the h-p gas turbine driving the compressor and then flows through the l-p turbine (in the same casing) driving the 6-mw generator.

Gas leaves the turbine at slightly above atmospheric pressure and 917 F to enter the economizer. From here, at 508 F, it enters the stack-gas cooler to heat feedwater and leaves at 300 F to exaust through the plant stack.

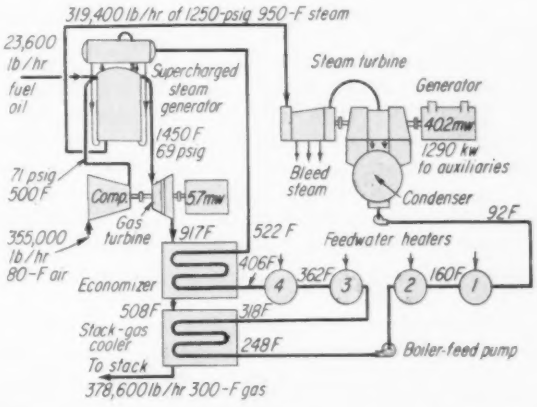
The supercharged-furnace boiler delivers 1250-psig 950-F steam to the 44-mw steam turbine. The turbine-generator uses a conventional 4-bleed-point regenerative cycle for feedwater heating. In place of a conventional feedwater heater the cycle uses a stack-gas cooler to recover heat from boiler leaving gases.

Savings. A variety of studies show that fuel savings vary by about 4 to 6% over an equal-capacity conventional steam generator for a combination plant. The entire plant proves to be more compact, needing smaller building volume. One limitation arises: the boiler can burn any fuel except coal. While considerable development work has been done on using coal for firing a gas turbine, much still remains to be done to make it commercially acceptable.





3 Warwick station steam generator has economizer, air heater in parallel; dampers put them in and out of service as needed



4 Supercharged furnace of steam generator also acts as gas-turbine combustor to make significant improvement in heat rate

Power development projects range over many energy systems

Internal-combustion engines made a marked advance during World War II when supercharging was developed for 4-cycle diesel engines. Exhaust-gas turbochargers force more air into the cylinders raising outputs by 50% and brake-mean-effective pressures from 80 to 120 psi; fuel economy improves by about 10%. All this was done with a slight increase in manufacturing cost.

Today 4-cycle engines develop mep's as high as 200 psi. Practically all engines use superchargers as standard equipment, with concurrent gains in thermal efficiency. Two-cycle engines with supercharging became available in 1954; a positive-displacement blower clutched to the main crankshaft solved the starting and low-load problems. Supercharging raises mep's from 65 to 150 psi and cuts fuel consumption by about 10%.

Automatic controls for most types of i-c engines continue to be improved to the point that remote control becomes practical. These make possible central control rooms in manned plants.

Boiler-feed pump drives strive for more speed flexibility as quantities and pressures grow. Important savings can be made by varying speed with flow, especially for the larger capacity pumps. Good performance leads design thinking toward dispensing with standby pumps. Trends show plants using two full-size pumps, three half-size pumps, two half-size pumps, and now one full-size pump. After years of using motor drives, some designers find economic advantage in returning to steam-turbine drives, especially for the high-pressure high-temperature cycles.

Turbine advantage lies in large powers up to 20,000 hp and more, and speed flexibility. Turbine bleeds steam from main unit and may exhaust either to a cycle heater or a condenser. These turbines may also be bled for feedwater heating. Ultimate in drives is the main steam turbine powering the feed pump through a fluid coupling. The full-size pump must be backed up by a smaller pump for starting the plant. Elements of cross-compound units will drive half-capacity feed pumps. For the large-capacity units coming into service, these pumps need fluid couplings of the largest ratings.

Superpressure plants make particularly urgent demands for high-speed pumps. This simplifies pump design but needs high-speed drive or a conventional motor drive through a stepup gear. Booster pumps prove useful in superpressure cycles.

Controlled circulation of water-steam flow in boilers finds increasing acceptance; over 100 units are projected or operating. POWER's survey shows 54 units are projected to start during 1958 and later. Several pumps taking suction from the boiler drum assure proper circulation through boiler-tube circuits before furnace lightoff.

With assured circulation, tube diameter becomes less important in its effect on water distribution and smaller tubes may be used with thinner walls at higher pressures. Pumping energy raises auxiliary power demands of the plant, but the pumps need only overcome frictional resistance of the tube circuits, even though the pump runs under high-pressure high-temperature conditions. Pump design must meet the special operating conditions of handling practically saturated water. One step toward eliminating the sealing problem uses submerged pumps in which the boiler water completely fills spaces in the motor. Most pumps, however, use more conventional designs with feedwater injected between impeller and stuffing box of the pump to aid shaft sealing.

Pressurized furnaces for steam generators find increasing favor in new plants. POWER's survey shows 95 scheduled for 1957, and later, which grew to 107 scheduled for 1958, and later. By stepping up f-d fan outlet pressures to about 60-in. wg to develop about 20-in. furnace pressures the i-d fan can be eliminated. Handling all the pressure development at the cold end of the gas circuit saves in overall fan power and capital investment.

Partly offsetting these advantages are needs for a costlier gastight boiler setting, and special methods of removing ash through air locks. But the gastight setting pays off in raising boiler efficiency by as much as 0.5% by eliminating air infiltration.

Motors continue as the favorite fan drive with flow control by vanes. Relatively few plants control air and gas flow by varying fan speed with 2-speed motors or by fluid or magnetic couplings. Increasing hp ratings on our largest boilers may make mechanical-drive turbines a possibility.

Shot cleaning of boiler convection surfaces, undergoing intensive development in the U.S.A., has been used for some years in Europe. The system injects iron shot about ¼-in. diameter at the top of the boiler passes. As the shot caroms off the boiler tubing it dislodges accumulated slag. Shot and slag fall to the hoppers below. About 98% of the shot is

recovered by magnetic separators as the ash leaves the hoppers. Cleaning can be carried on while the boiler is under load.

Gas recirculation offers a method of controlling slag deposits on high-temperature surfaces. By recirculating controlled amounts of flue gas from the boiler outlet to mix with the furnace gases entering a boiler superheater, the temperature can be lowered enough to solidify flyash before it hits superheater surfaces. This setup also controls superheater outlet temperatures. The recirculating fan must handle hot ash-laden gases. Continuous operation is bought for the investment in the recirculating duct, dampers, fan and driver and operating cost of running the fan.

Outdoor plant equipment slowly gains favor in almost all climates. In 1957, POWER's survey showed 21% of all plants projected were completely outdoor. This grew to 23% in the present survey. Semi-outdoor plants were 19% in 1957 and 21% in 1958. Indoor plant percentages dropped from 60 to 55 in the two years. The Mercer Station of Public Service Electric and Gas Company will have the generators of its two 320-mw cross-compound units partly indoors and partly outdoors. Half-capacity feed pumps driven by the main turbines through hydraulic couplings will stand outdoors. The outdoor boilers will have no coal bunkers, only outdoor silos with a 4-hr capacity fed from ground storage.

Turbine capacity per unit keeps growing with the expanding national appetite for electrical energy. POWER's surveys in 1957 and 1958 showed these increases and comparisons for the basic turbine types:

	No. of turbines		Average capacity, mw		
Year	Reheat	Regenerative	Reheat	Regenerative	All
1957	227	108	165	32	122
1958	206	94	169	34	127

In the one-year interval average capacity of all units reported grew by 5000 kw. Both surveys included the 500-mw General Electric unit planned for Widows Creek Station of the TVA. This is the largest projected in the U.S.A. The cross-compound unit, 3600/1800 rpm, will have two exhausts to a 200,000-sq-ft condenser. The two 24-kv generators will have hollow-conductor-cooled rotors and liquid-cooled stators. A 3,850,000-lb-per-hr Combustion Engineering, Inc steam generator will feed 2400-psig 1050-F steam and reheat it to 1000 F. The heat balance will use eight heaters to produce 530-F feedwater. The entire plant will be indoors.

World's largest turbine will be the 550-mw unit being built by C A Parsons and Co, Ltd for a new British station, Thorpe Marsh. International Combustion, Ltd will build the single boiler to supply 2300-psig 1050/1050-F steam. The 3000/3000-rpm cross-compound unit has four turbine casings in each element, all of them double flow. Each will drive an 18-kv 0.85-pf generator with water-cooled stator windings and 45-psig hydrogen-cooled rotor. Seven bleed points will heat feedwater to 486 F. The four l-p turbines will exhaust steam through eight outlet nozzles to four main condensers with a total of 330,000 sq ft of heat-transfer surface. Rated turbine backpressure is 1.3 in. Hg. The boiler will burn coal with 30% ash and 20% moisture.

Turbine design advances continue to be made as manufacturers explore new possibilities. With the obvious and measurable gains that could be made by pushing up throttle conditions, much attention had been concentrated on the turbine front end. Suspecting that performance could be improved in the l-p stages, General Electric Co has set up a laboratory to research this area. Work done to date has improved efficiency level by 3%.

Close coupling with either crossovers or cross-unders of cross-compound units has mitigated the problem of stored steam on emergency shutdown. Allis-Chalmers has designed a turbine-generator with its center line at the same level as the turbine-room floor line. This eliminates access platforms above the operating floor and gives more room under the floor to accommodate heaters and turbine piping.

Largest exhaust blading has reached 26 in. for 3600-rpm turbines and 46 in. for 1800-rpm units. Metallurgists continue their efforts to develop economical materials for more severe steam conditions and higher mechanical stresses.

Station designers continue to explore such advanced ideas as: binary cycle with steam topping a low-temperature Freon cycle to reduce turbine stage and exhaust losses; using benzine as the working fluid instead of steam in nuclear-fueled cycles; designing low-cost steam turbines for peaking; using liquid metals or steam to reheat steam at the turbine transition points; multiple reheat steam cycles with intermediate throttle steam conditions. Practically all of these showed that the investment in additional equipment over conventional cycle arrangements outweighed any of the thermal economies gained.

Stack dry-gas loss is the second largest loss in today's high-efficiency central stations. Two approaches to cutting this loss have been used by pioneering designers. In River Rouge Unit No. 3, Detroit Edison Co, a second cold-gas air heater follows the primary hot-gas air heater, dust collector and i-d fan in the gas circuit. The cold-gas air heater reduces stack-gas temperature to 200 F at full boiler load; it can be bypassed on both air and gas sides for cleaning and maintenance without shutting down the steam generator. Design studies showed this heater raised boiler efficiency by 1½% for a net annual fuel saving of $70,000, which gave a good return on the added investment.

Philadelphia Electric Co in its Eddystone Unit No. 1, the highest pressure unit projected, cuts dry-

gas loss with another scheme. Instead of using boiler air as the heat-recovery agent they use boiler feedwater. After leaving the first l-p heater the feedwater flows to the low-temperature economizer which lowers stack gas to 200 F. From here the feedwater returns to pass through the rest of the bleed-steam feedwater heaters. The low-level economizer replaces one normal feedwater heater. As a separate feature this unit uses an air tempering arrangement for cold-weather conditions at the f-d fan inlet. Water heated in the l-p heater supplies the tempering energy to prevent condensation and corrosion in the gas-side of the air heater. Studies show an overall saving of 100 Btu per kwhr in station heat rate for the recovery scheme.

Station design economies can be boosted by using larger units and taking a hardheaded attitude in selecting station accessories. Detroit Edison Co estimates they saved $45 per kw in their new River Rouge Plant compared to the predecessor St. Clair Plant. About $33 per kw can be credited to a larger station (3 units) 875 mw compared to (4 units) 660 mw. The $12 per kw saving was estimated this way:

Main building—eliminating sub-basement, metal walls replacing brick, higher stressed building steel, etc	$3,600,000
Miscellaneous bldgs—reducing warehousing, screen-house structure	600,000
Boiler plant—constant-speed fans, higher pipe velocities, better price	660,000
Coal handling—mobile equipment	3,200,000
Water-treatment plant	140,000
Air-cooled transformer	100,000
Total saving	$8,300,000

Critical study of available auxiliary equipment can yield savings equal to thermal efficiency gains.

Surface condenser arrangements may be tailored to meet practically any condition. The familiar tube layout circumscribed by a circular shell has been largely replaced by a rectangular layout with a payoff in lower headroom needs. Side-mounted side-entry condensers, single or in pairs, save as much as 40% headroom. In the ultimate installation they have been placed on the operating floor next to the turbine. Other floor-mounted condensers serve axial-exhaust turbines (see Portland story). Turbine-supporting condensers have been built for units as large as 100 mw, saving in headroom and foundation costs. Two sets of tube bundles and waterboxes have become nearly universal to allow taking out one section of a condenser at a time for cleaning without shutting down the unit. A variety of cooling-water reversing arrangements are available for quick tube-sheet cleaning.

Station ventilation raises many problems for the plant designer. Intensive research has enabled some groups to develop rational approaches to the varied problems that arise for plants of different arrangements. R W Patterson, Sargent & Lundy, recommends following procedure: (1) Choose maximum allowable temperatures. (2) Calculate heat radiated by equipment. (3) Calculate volume of air needed to carry off heat and maintain temperature limits. (4) Design air distribution pattern and locate air inlets and outlets. (5) Choose opening types and figure areas. (6) Carefully study hot spots and figure special ventilation or cooling needed. *Maximum* temperatures recommended are 110 F for men in constant attendance, 120 F for areas infrequently entered and 104 F for electrical controls, cables.

Nuclear power reactors now producing heat have increased to seven, see Plant Survey. The largest is the commercial-sized 60-mw Shippingport Plant which has produced more than 40-million kwhr net output. This reactor is the largest power reactor in the world today and uses the pressurized-water principle. The 64-mill-per-kwhr overall production cost does not represent the best economy that could be achieved today. Shippingport is experimental and rigged to undergo extensive testing.

Experience with the EBWR boiling-water reactor at Lemont, Ill., offers the brightest hope for economical nuclear power. This 20-mwt-rated reactor has actually produced 62 mwt because of much higher natural-water circulation in the core than anticipated. With a 15-mw turbine, this unit could produce 32-mill-per-kwhr power. Extrapolating this experience to a 240-mw plant the designers estimate they can produce 12-mill power. Steam and water radioactivity levels are so low that operators and maintenance men can work directly on all equipment outside the biological shield.

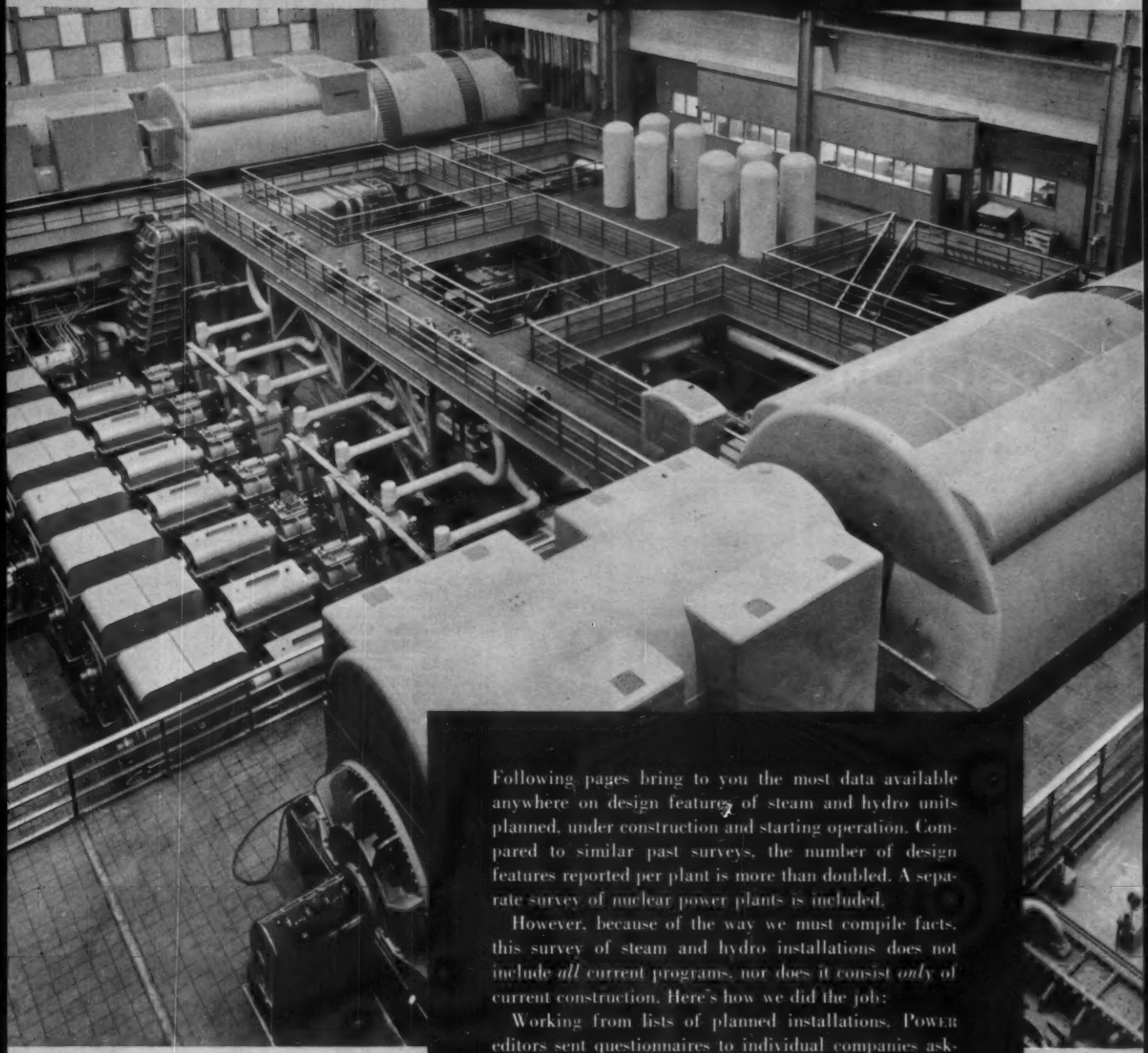
Controlled-circulation boiling-water reactors appear to offer greatly increased capacity for a given core by stepping up heat-transfer rates. An Allis-Chalmers project for the Northern States Power Company now contemplates incorporating nuclear superheating of the steam. Water enters the circulating pumps' suction from the bottom of the reactor vessel to be discharged up through the core. At the core exit the steam bubbles rise through the water above to break into the steam dome. The water returns to the bottom of the vessel to be recirculated. Steam pipes projecting through the center of the core into the steam dome gather the steam and lead it down through the hot core to be superheated to 825 F at 600 psig as it flows to the turbine.

Waste disposal of nuclear-reactor radioactive materials and residues into isolated geologic formations underground is being studied. AEC scientists now believe that this method will raise the temperature of the formations by the order of hundreds of degrees Centigrade.

Several AEC laboratories now try to immobilize radioisotopes into glass, ceramics and synthetic materials. Studies and tests show that these mixtures are practically unleachable.

Power
OCTOBER 1958

Central Station Design Survey



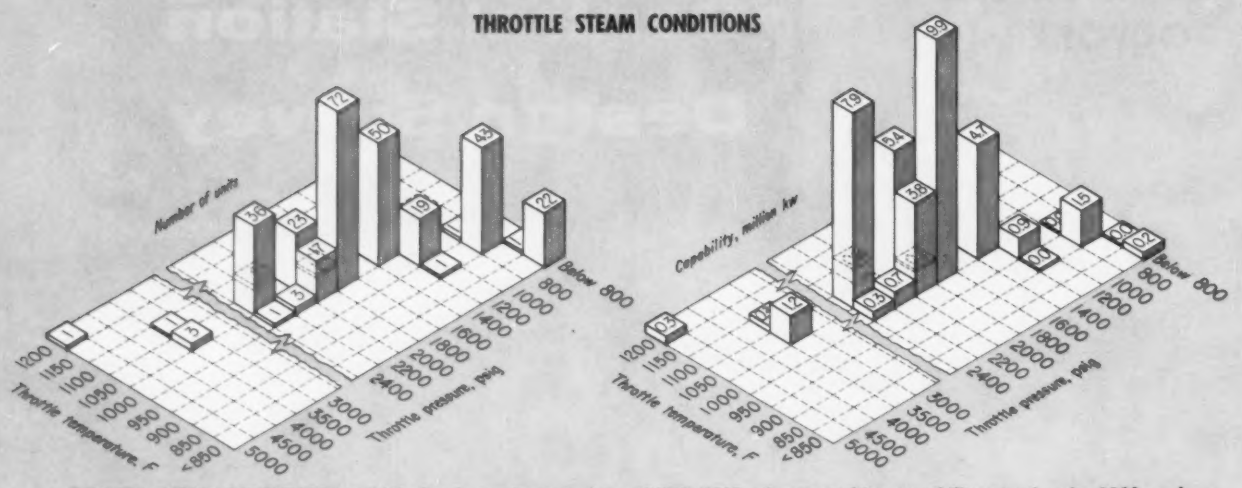
Following pages bring to you the most data available anywhere on design features of steam and hydro units planned, under construction and starting operation. Compared to similar past surveys, the number of design features reported per plant is more than doubled. A separate survey of nuclear power plants is included.

However, because of the way we must compile facts, this survey of steam and hydro installations does not include *all* current programs, nor does it consist *only* of current construction. Here's how we did the job:

Working from lists of planned installations, POWER editors sent questionnaires to individual companies asking for project details. Replies went into the tables. Data may appear in the following tables well before construction starts; or if engineering is delayed, may not appear until long after a project is announced.

Being representative of design and construction in late 1957 and early 1958, the following tables give useful information on general trends. But you can see that by the very nature of things these tabulations can't be complete. Consider them as extensive samples. Don't use the survey to get total capacities, sales, etc. or to make comparisons where incompleteness could distort results.

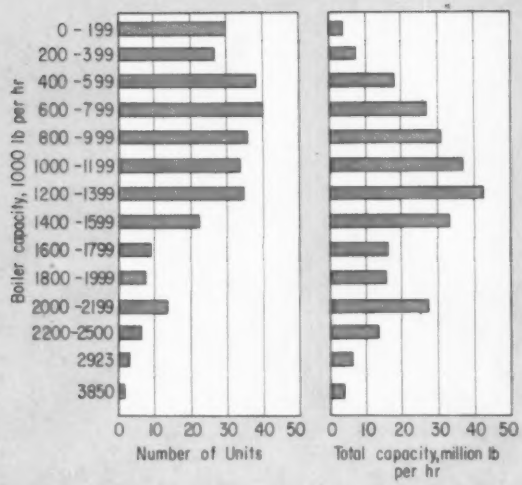
B G A SKROTZKI
Associate Editor in Charge



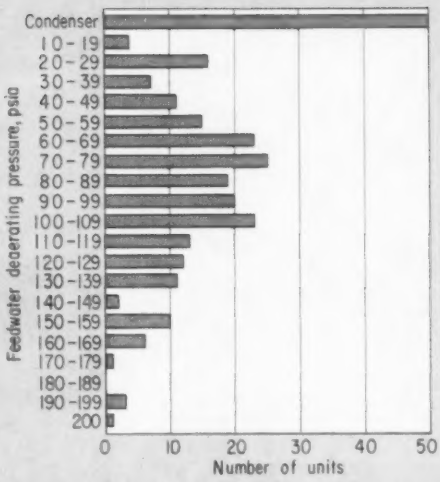
THROTTLE STEAM CONDITIONS at high levels continue to be favored for new and projected units in year 1958 and later

OVER HALF of new turbine capability starting in 1958 and later will use throttle steam at 2000 psig, 1000 F and up

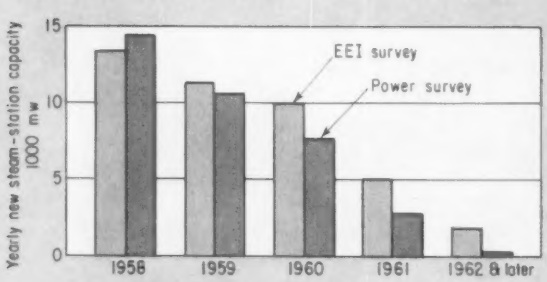
Trends in CENTRAL STATIONS



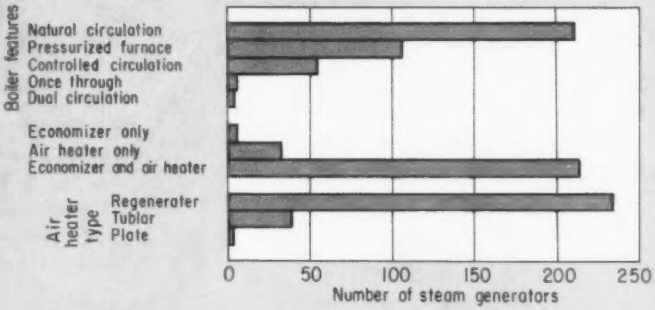
STEAM-GENERATOR RATINGS keep in step with demand for larger power packages; largest generates 3,850,000 lb per hr



FEEDWATER DEAERATING pressures in excess of 70 psia are favored by majority of units; about 20% use condenser only

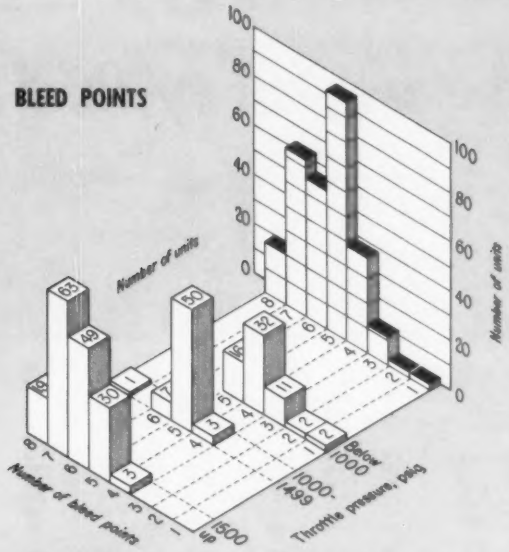


POWER SURVEYS in this and previous reports cover about 90% of 41-million-kw steam capability scheduled for 1958-1961

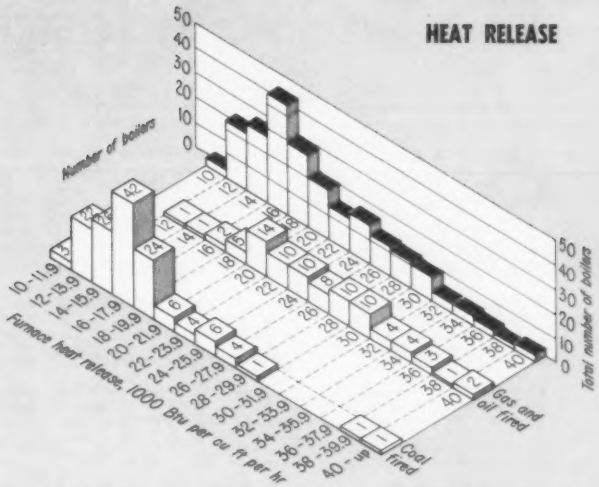


STEAM-GENERATOR FEATURES show growing use of all heat-recovery units, increasing acceptance of pressurized furnaces

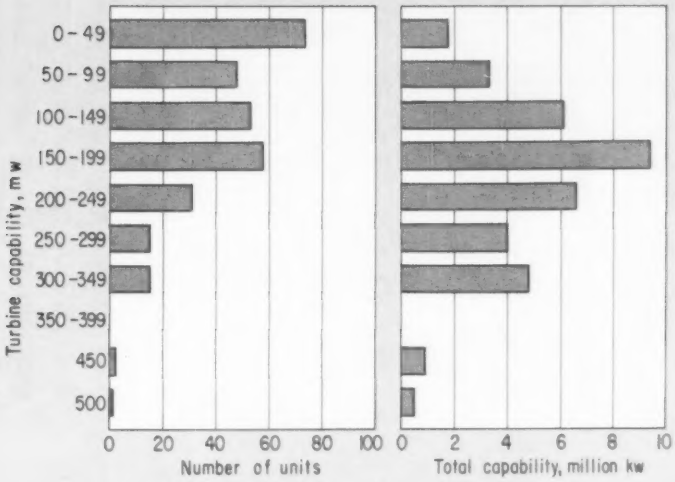
TABLE 1



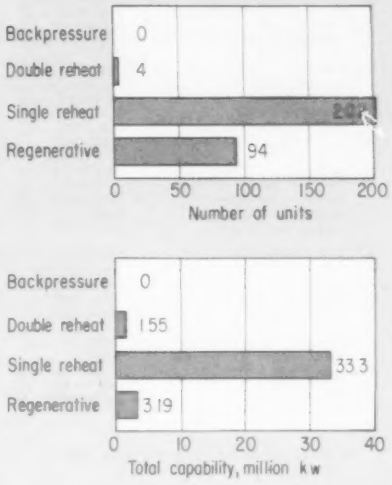
FIVE BLEED POINTS still predominates for all turbines but seven points finds most frequent favor for the high-pressure units


HEAT RELEASE
Number of boilers
Furnace heat release, 1000 Btu per cu ft per hr
Total number of boilers
Gas and oil fired
Coal fired

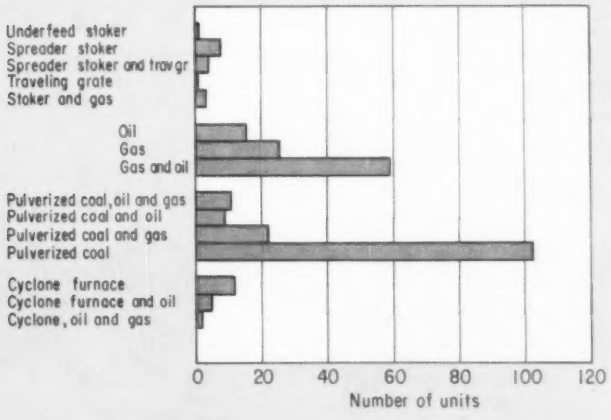
FURNACE HEAT RELEASE rate continues to stay mostly at lower levels for coal-fired boilers, ranges 20-30,000 for oil fuels



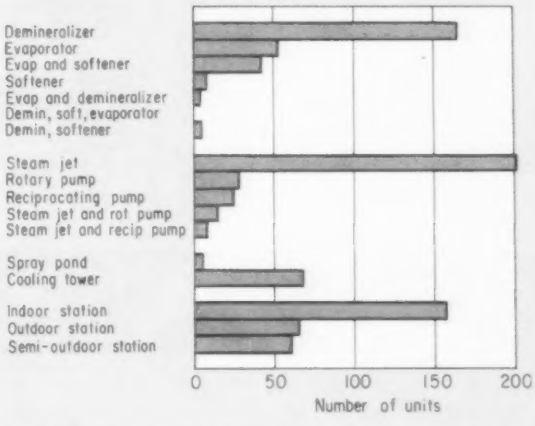
TURBINE CAPABILITIES and number of units show about same distribution as in 1957 survey but average capacity has grown from 122 mw to 127 mw for all types



REHEAT TURBINES are preferred for new units, they have average size of 169 mw



FIRING EQUIPMENT shows about same proportion of coal-fired furnaces as in 1957 survey; coal still predominates



STATION FEATURES show indoor plants are now about 55% of total compared to 60% in 1957 survey and previous ones

TABLE 1

1958 design survey of typical

Note that each listing covers four pages. The project number helps you keep track of a specific installation after you turn the facing page

Project No.	Company	Location	Plant Name	Consulting Engineers	Unit No., new unit	First operation, new unit	Throttle pressure, psig	Steam temperature, F		Reheat	
								Throttle	Reheat	Number	Capacity each, 1000 lb per hr
1	Central Hudson Gas & Electric Corp.	Roseton, N.Y.	Danskammer Point	Burns and Roe, Inc.	3[1]	9-59	2400	1050	1000	1	950
2	Consumers Power Co	Essexville, Mich.	Dan E. Karn	Commonwealth Associates Inc	2[1]	3-61	2400	1050	1000	1	1750
3	Metropolitan Edison Co	Portland, Pa.	Portland	Gilbert Associates, Inc.	1[9]	9-58	2400	1050	1050	1[5,2]	1150
4	Potomac Electric Power Co	Dickerson, Md.	Dickerson "D"	Stone & Webster Engrg Corp	1[1]	5-59	2400	1050	1000	1	1300
5	Potomac Electric Power Co	Dickerson, Md.	Dickerson "D"	Stone & Webster Engrg Corp	2	4-60	2400	1050	1000	1	1300
6	Connecticut Light and Power Co	South Norwalk, Conn.	Norwalk Harbor	United Engrs & Constructors, Inc.	1[1]	9-60	2000	1000	1000	1	1150
7	Florida Power & Light Co	Hollywood, Fla.	Port Everglades	Bechtel Corp	1	4-60	2000	1000	1000	1[2]	1550
8	Louisiana Power & Light Co	Laplace, La.	Little Gypsy	Ebasco Services Inc	1	1-61	2000	1000	1000	1[2]	1650
9	Union Electric Co	St. Louis County, Mo.	Meramec		4	4-61	2000	1000	1000	1[5]	2310
10	Arizona Public Service Co	Tempe, Ariz.	Ocotillo	Ebasco Services Inc	1[1]	2-60	1800	1000	1000	1[2]	800
11	Arizona Public Service Co	Tempe, Ariz.	Ocotillo	Ebasco Services Inc	2[1]	4-60	1800	1000	1000	1[2]	800
12	California Electric Power Co	San Bernadino, Calif.	San Bernadino	The Fluor Corp, Ltd	2[1]	5-58	1800	1000	1000	1[2]	450
13	California Electric Power Co	Daggett, Calif.	Cool Water	The Fluor Corp, Ltd	1	4-61	1800	1000	1000	1[2]	475
14	Dallas Power and Light Co	Dallas, Tex.	North Lake	Ebasco Services Inc	2[1]	1-61	1800	1000	1000	1[2]	1200
15	Duquesne Light Co	Elrama, Pa.	Elrama	Stone & Webster Engrg Corp	4	4-60	1800	1000	1000	1	1300
16	Gulf States Utilities Co	Westlake, La.	Roy S. Nelson	Stone & Webster Engrg Corp	3	4-60	1800	1000	1000	1[2]	1100
17	Gulf States Utilities Co	St. Gabriel, La.	Willow Glen	Stone & Webster Engrg Corp	1	4-60	1800	1000	1000	1[2]	1100
18	Kansas Gas and Electric Co	Wichita, Kan.	Gordon Evans	Ebasco Services Inc	1[1]	3-61	1800	1005	1005	1	1020
19	Northern States Power Co	Minneapolis, Minn.	Black Dog	Pioneer Service & Engrg Co	4	1960	1800	1000	1000	1	1250
20	Public Service Co. of New Hampshire	Bow, N.H.	Merrimack	Jackson & Moreland, Inc.	1	10-60	1800	1000	1000	1[5]	815
21	Tampa Electric Co	East Tampa, Fla.	Gannon	Stone & Webster Engrg Corp	3	10-60	1800	1000	1000	1[5]	1160
22	Indianapolis Power & Light Co	Indianapolis, Ind.	Harding St	Gibbs & Hill, Inc	6	6-61	1535	1000	1000	1	750
23	Central Illinois Electric & Gas Co	Rockford, Ill.	Sabrooke	Stone & Webster Engrg Corp	4	6-61	1525	1000	1000	1	410
24	Atlantic City Electric	Pennsgrove, N.J.	Deepwater	Gibbs & Hill, Inc.	1[1]	11-58	1450	1000	1000	1	616
25	Central Power and Light Co	Mission, Tex.	J. L. Bates	Sargent & Lundy	2	5-60	1450	1000	1000	1[2]	800
26	El Paso Electric Co	Newman, Tex.	Newman	Stone & Webster Engrg Corp	1	3-60	1450	1005	1005	1[2]	560
27	Public Service Co. of Colorado	Denver, Colo.	Cherokee	Ebasco Services Inc	2[1]	4-59	1450	1000	1000	1[5]	1140
28	Public Service Co. of Colorado	Cameo, Colo.	Cameo	The Fluor Corp Ltd	2[1]	5-60	1250	950	N	1[5]	425
29	Puerto Rico Water Resources Auth.	Palo Seco, P.R.	Palo Seco	Jackson & Moreland, Inc.	1	1960	1450	1000	1000	1[2]	650
30	Puerto Rico Water Resources Auth.	Palo Seco, P.R.	Palo Seco	Jackson & Moreland, Inc.	2	—	1450	1000	1000	1[2]	650
31	Southwestern Gas and Electric Co	Shreveport, La.	Arsenal Hill	Sargent & Lundy	5	4-60	1450	1000	—	1[2]	850
32	Southwestern Public Service Co	Amarillo, Tex.	Nichols		1	5-60	1450	1000	1000	1[5]	800
33	Wisconsin Public Service Corp	Rothschild, Wis.	Weston	Pioneer Service & Engrg Co	2	10-60	1450	1000	1000	1	600
34	Missouri Public Service Co	Sibley, Mo.	Sibley	Burns & McDonnell Engrg Co	2	—	1250	950	—	1	450
35	Public Service Co of New Mexico	Albuquerque, N.M.	Reeves	Stearns-Roger	2[1]	12-58	1250	950	—	1[5]	425
36	Southern Nevada Power Co	Whitney, Nev.	Clark		3	1961	1250	950	—	1[2]	650
37	Upper Peninsula Power Co	L'Anse, Mich.	John H. Warden	Stone & Webster Michigan, Inc.	1	—	875	900	—	1	220
38	Central Kansas Power Co	Hill City, Kan.	Ross Beach	Black & Veatch	2	1959	850	900	—	1	235
39	Mid-Tex Generation & Transmission	Abilene, Tex.		Tippett & Gee	1	1960	850	900	—	1[2]	225
40	Mid-Tex Generation & Transmission	Abilene, Tex.		Tippett & Gee	2	1960	850	900	—	1[2]	225
41	St. Joseph Light & Power Co	St. Joseph, Mo.	Lake Road	Black & Veatch	2[8]	10-57	850	900	—	1[5]	250
42	Seaboard Power Corp	Glace Bay, N.S.	Seaboard		6	9-59	630	800	—	1	200
43	Spruce Falls Power & Paper	Kapuskasing, Ont.		H. G. Acres & Co Ltd	—	9-59	285	560	—	1	185
	MUNICIPAL, FEDERAL AND COOPERATIVE INSTALLATIONS										
44	Tennessee Valley Authority	Bridgeport, Ala.	Widows Creek		7[1]	9-60	2400	1000	1000	1	3850
45	Hydro-Electric Power Comm of Ontario	Toronto Twp, Ont.	Lakeview	Stone & Webster Engrg Corp	1	1961	2350	1000	1000	1	2000
46	Hydro-Electric Power Comm of Ontario	Toronto Twp, Ont.	Lakeview	Stone & Webster Engrg Corp	2	1961	2350	1000	1000	1	2000
47	Hydro-Electric Power Comm of Ontario	Toronto, Ont.	R. L. Hearn	Stone & Webster Engrg Corp	5[9]	1958	1800	1000	1000	1	1350
48	Hydro-Electric Power Comm of Ontario	Toronto, Ont.	R. L. Hearn	Stone & Webster Engrg Corp	6[1]	1959	1800	1000	1000	1	1350
49	Hydro-Electric Power Comm of Ontario	Toronto, Ont.	R. L. Hearn	Stone & Webster Engrg Corp	7[1]	1960	1800	1000	1000	1	1350
50	Hydro-Electric Power Comm of Ontario	Toronto, Ont.	R. L. Hearn	Stone & Webster Engrg Corp	8[1]	1960	1800	1000	1000	1	1350
51	Hydro-Electric Power Comm of Ontario	Fort William, Ont.	Thunder Bay	Ewbank & Partners Ltd	1	—	1450	1000	—	1	850
52	Cent'l Neb. Public Pwr & Irrigation Dist.	Lexington, Neb.	Canaday	Sargent & Lundy	1[9]	5-58	1800	1005	1005	1	750
53	Consumers Public Power District	Hallam, Neb.	Sheldon	Stearns-Roger	1	1960	1800	1005	1005	1[5,10]	790
54	Orlando Utilities Commission	Delespine, Fla.	Indian River	Black & Veatch	1	10-59	1800	1000	1000	1[2]	635
55	New Brunswick Electric Power Comm	E. St. John, N.B.		H. G. Acres & Co Ltd	1	7-60	1450	1000	—	1	460
56	City of Burbank	Burbank, Calif.	Olive Ave	Fluor Corp, Ltd	1	4-59	1280	959	—	1[5]	425
57	Braintree Electric Light Dept	Braintree, Mass.	N. P. Potter	Gilbert Associates Inc	1	11-59	1250	950	—	1	130
58	E. Kentucky Rural Electric Coop Corp	Ford, Ky.	Wm. C. Dale	Stanley Engineering Co	4[1]	10-60	1250	950	—	1[5]	623
59	City of Glendale	Glendale, Calif.	Municipal		4	10-59	1250	950	—	1[5]	425
60	City of Jacksonville	Jacksonville, Fla.	Southside	Reynolds, Smith & Hills	4[1]	11-58	1250	950	—	1	650
61	City of Fort Pierce	Fort Pierce, Fla.	Municipal	Reynolds, Smith & Hills	5	11-57	900	900	—	1	175

SYMBOLS USED ABOVE

- Af - Attemperator
- By - Gas bypass
- Coil - Cooling coils
- Cool - Boiler water cooling
- D - Damper
- DB - Dry bottom
- Du - Dual turbine and motor drive
- FG - Flue gas recirculation
- Hy - Hydraulic coupling
- Lo - Inlet louvre
- M - Motor drive
- Ma - Magnetic coupling
- Mp - Two motors per fan
- N - None
- No - Number of burners
- Pl - Plate
- Pre - Precondensing
- Re - Regenerative
- S - Speed control
- ST - Slag tap
- T - Turbine drive
- TB - Tilting burners
- Tu - Tubular
- V - Vane control
- WS - Water spray

1 - Revised data, previously 12-57
2 - Outdoor unit
3 - 1000 Btu per sq ft per hr
4 - Pressurized furnace
5 - Semioutdoor unit
6 - Proportional gas flow through divided superheater, reheater convection section
7 - 1000 lb per hr
8 - Turbine no. 2, boiler no. 5
9 - Revised data, previously listed 9-56
10 - Boiler operates initially at 850 psig, 900 F; serves as standby for sodium graphite reactor
11 - Combination gas and coal firing with spreader stoker and traveling grate
12 - Once through boiler
13 - Excess air with water spray "backup"

MANUFACTURERS

- AB - American Blower Corp
- AC - Allis-Chalmers Mfg Co
- AH - American Hoist & Derrick Co
- AP - Aico Products, Inc
- AR - American Radiator and Standard Sanitary Corp
- ASH - Allen-Sherman-Hoff Co
- AT - Aerotec Corp
- B - Bros, Inc
- BB - Brown Boveri (Canada) Ltd
- BE - Beaumont Birch Co
- BF - Buffalo Forge Co
- BFS - B F Sturtevant Co of Canada Ltd
- BJ - Byron-Jackson Pumps, Inc
- BM - Bailly Meter Co
- BS - C O Bartlett & Snow Co
- BT - British Thompson-Houston Co, Ltd
- BU - Buell Engineering Co, Inc
- BW - Babcock & Wilcox Co

new central-station installations

Manufacturer	BOILERS: Surface, 1000 sq ft: Boiler & Waterwalls	Superheater	Reheater	Economizer	Air heater	Superheat control	Reheat control	Air heater type	FURNACE: Pressure, in. water	Volume, 1000 cu ft	Heat release, 1000 Btu per cu ft per hr	No. of burners	Bottom	F-D FANS: No. per boiler	Capacity each, 1000 cfm	Manufacturer	Air flow control	Drive	Drive hp	Drive manufacturer	I-D FANS: No. per boiler	Capacity each, 1000 cfm	Manufacturer	Gas-flow control	Drive	Drive hp	Drive manufacturer	Project No.
CE	17.0	78.3	16.3	62.7	112.7	WS,TB	WS,TB	Re	-1.0	69.1	17.5	24	DB	2	150	AB	V	M	400	GE	2	240	AB	D	M	1000	GE	1
BW	25.8	139.0	30.3	16.8	369.0	WS,No	WS,FG	Re	0.1	136.0	16.3	24	DB	2	315	WE	V	M	800	AC	2	480	WE	V	M	1750	AC	2
CE	20.3	—	—	51.0	104.7	WS	TB	Re	0.5	119.3	12.1	16	DB	2	209	WE	V	M	612	WE	2	292	WE	D	M	1250	WE	3
CE	24.2	173.8	23.6	62.6	237.5	WS	TB	Re	-0.1	93.5	17.6	32	DB	2	210	AB	Lo	M	700	EM	2	295	AB	Hy	M	1000	EM	4
CE	24.2	173.8	23.6	62.6	237.5	WS	TB	Re	-0.1	93.5	17.6	32	DB	2	210	AB	Lo	M	700	EM	2	295	AB	Hy	M	1000	EM	5
CE	19.3	72.0	16.8	30.0	138.9	WS,TB	WS,TB	Re	-0.1	85.0	17.3	32	DB	2	200	SW	V	M	700	WE	2	350	SW	V	M	1500	WE	6
CE	17.4	82.4	26.2	49.2	208.6	WS,FG	WS,FG	Re	—	124.8	98.0[3]	16	DB	2	320	AB	D,V	M	900	GE	2	458	AB	D,Hy	M	1750	GE	7
RS	60.4	78.8	72.0	24.8	324.2	WS,By	WS,D	Re	—	104.3	20.7	18	ST[4]	2	232	AB	V	M	1000	GE	N	—	—	—	—	—	—	8
FW	39.9	62.5	74.7	—	174.0	WS	—[6]	Re	-0.1	185.0	15.4	18	DB	2	—	—	V	M	—	—	2	—	—	D	M	—	—	9
CE	11.2	36.0	8.3	15.8	—	WS	TB	Re	11.2	58.0	22.1	32	—[4]	2	147	SW	V	M	600	EL	N	—	—	—	—	—	—	10
CE	11.2	36.0	8.3	15.8	—	WS	TB	Re	11.2	58.0	22.1	32	—[4]	2	147	SW	V	M	600	EL	N	—	—	—	—	—	—	11
CE	13.2	31.4	6.3	5.0	62.2	WS,TB	WS	Re	6	30.8	23.4	24	—[4]	2	105	WE	D,V	M	450	WE	N	—	—	—	—	—	—	12
CE	11.4	—	—	11.6	77.2	WS,TB	WS,TB	Re	8.2	24.1	28.1	24	DB[4]	1	180	—	S,V	Mp	900/125	GE	N	—	—	—	—	—	—	13
RS	52.8	44.4	35.5	19.2	168.8	WS,By	WS,D	Re	8.2	57.0	28.3	16	—[4]	2	—	AB	D	M	1000	AC	N	—	—	—	—	—	—	14
BW	24.7	89.1	32.2	32.1	220.4	WS,FG	FG	—	0.1	108.5	16.3	20	DB	2	260	SW	V	M	700	GE	2	387	SW	V	M	1000	GE	15
CE	19.6	57.8	12.9	34.4	168.0	WS,TB	WS,TB	Re	7	—	—	40	—[4]	2	197	SW	D,V	M	1000	GE	N	—	—	—	—	—	—	16
CE	19.7	57.8	13.0	34.4	168.0	WS,TB	WS,TB	Re	7	91.0	—	40	—[4]	2	197	SW	D,V	M	1000	WE	N	—	—	—	—	—	—	17
RS	34.8	49.9	55.2	14.0	168.8	By	By	Re	9	54.0	27.0	12	—[4]	2	180	WE	V	M	800	WE	N	—	—	—	—	—	—	18
BW	26.2	73.7	52.0	11.6	229.0	WS,FG	WS,FG	Re	-0.1	91.7	18.2	16	DB	2	250	BF	Ma	M	800	EM	2	420	BF	Ma	M	1500	EM	19
BW	16.6	39.4	15.0	25.3	167.6	WS,FG	WS,FG	Re	13	37.1	—	3	ST[4]	2	157	BF	V	M	2000	WE	N	—	—	—	—	—	—	20
BW	—	—	—	—	—	WS,FG	WS	Re	15	66.6	25.4	4	ST[4]	2	200	WE	V	M	3000	WE	—	—	—	—	—	—	—	21
CE	19.2	44.2	10.5	18.2	126.8	WS,TB	WS,TB	Re	0.15	65.0	15.6	16	DB	1	242	—	V	Mp	600/350	—	D	392	—	D	Mp	1500/800	—	22
CE	14.3	30.7	4.5	8.9	81.5	WS	TB	Re	-0.15	37.1	13.8	16[37]	DB	—	—	—	—	—	—	—	—	—	—	—	—	—	—	23
BW	9.7	—	—	8.3	—	WS	WS	Re	48.8	—	39.0	3	ST[4]	2	115	WE	V	M	1250	WE	N	—	—	—	—	—	—	24
RS	17.7	33.0	29.0	11.0	165.4	WS	D	Re	4	34.4	30.0	12	—[4]	2	140	AB	V	M	700	GE	N	—	—	—	—	—	—	25
BW	10.6	13.2	6.9	16.4	84.4	WS	—[13]	Re	9.7	26.6	30.0	12	—[4]	1	188	WE	V	M	1000	WE	N	—	—	—	—	—	—	26
BW	36.4	38.7	28.6	20.1	281.3	WS,FG	WS	Tu	-0.35	18.8	14.7	12	DB	2	592[2]	SW	V	M	500	GE	2	710[7]	SW	—	M	1250	GE	27
BW	8.9	—	—	18.7	71.5	By	—	Re	-0.1	30.0	80.1[3]	8	DB	1	488[7]	SW	V	M	341	WE	1	560[7]	SW	V	M	646	WE	28
CE	16.8	37.7	6.6	16.6	93.0	WS,TB	WS,TB	Re	—	39.1	22.3	12	DB	2	128	GF	V	M	300	FM	2	172	SW	V	M	350	WE	29
CE	16.8	37.7	6.6	16.6	93.0	WS,TB	WS,TB	Re	—	39.1	22.3	12	DB	2	128	GF	V	M	300	FM	2	172	SW	V	M	350	WE	30
CE	23.0	22.9	N	29.5	135.6	WS,TB	—	Re	22	60.3	18.3	32	—[4]	2	140	WE	V	M	700	AC	N	—	—	—	—	—	—	31
CE	21.1	—	—	18.3	120.8	WS,TB	WS,TB	Re	10.2	47.7	—	32	—[4]	2	145	SW	V	M	600	WE	N	—	—	—	—	—	—	32
CE	13.9	29.9	9.2	17.9	51.8	WS,FG	WS,FG	Re	0.15	49.3	16.4	9	DB	2	123	BF	Hy	M	350	GE	2	195	BF	Hy	M	700	GE	33
BW	7.1	—	—	6.9	110.1	WS	—	Tu	12	18.6	—	—	—	1	101	WE	V	M	1500	GE	N	—	—	—	—	—	—	34
BW	8.3	10.2	—	11.9	78.0	WS	—	Re	10	8.0	—	6	—[4]	1	158	SW	V	Mp	300/800	AC	N	—	—	—	—	—	—	35
CE	—	—	—	—	—	TB	—	Re	—	—	—	—	—[4]	—	—	AC	—	—	—	—	N	—	—	—	—	—	—	36
RS	—	—	—	—	—	WS	—	Tu	—	—	—	—	DB	—	—	—	V	M	—	—	—	—	—	D	M	—	—	37
BW	16.8	5.5	—	—	22.8	By	—	—	0.1	14.7	—	4	—	1	84.5	SW	S,V	Mp	125/200	AC	1	116	SW	D	Mp	150/350	AC	38
—	10.7	4.7	—	—	23.0	WS	—	Re	—	2.5	35.0	—	—[4]	1	—	—	V	M	—	—	N	—	—	—	—	—	—	39
—	10.7	4.7	—	—	23.0	WS	—	Re	—	2.5	35.0	—	—[4]	1	—	—	V	M	—	—	N	—	—	—	—	—	—	40
BW	18.7	11.2	—	—	39.7	Coil	—	Re	—	16.6	—	—	DB	1	—	—	D,V	M	—	—	1	—	—	D,Ma	M	—	—	41
FWL	20.8	5	—	—	39.0	—	—	Tu	0.2	14.4	17.9	6	DB	1	70	CBF	V	M	125	CGE	1	110	CBF	D	M	250	CGE	42
BWG	26.6	—	—	—	35.9	—	—	Tu	14.3	19.8	—	—	—	1	—	SW	V	M	—	CGE	1	—	SW	S	T	—	CGE	43
CE	54.2	255	52.3	265.0	682.4	WS	WS,TB	Re	0.1	429.2	11.2	40	DB	4	335	AB	V	M	1000	GE	4	460	AB	Hy	M	1750	GE	44
BWG	69.7	137.5	48.1	49.0	174.4	WS	WS,FG	Re	—	141.7	19.9	24	DB	2	317	JH	D,Hy	M	—	EE	2	476	JH	D,Hy	M	—	LD	45
BWG	69.7	137.5	48.1	49.0	174.4	WS	WS,FG	Re	—	141.7	19.9	24	DB	2	317	JH	D,Hy	M	—	EE	2	476	JH	D,Hy	M	—	LD	46
BWG	41.1	66.0	31.4	20.0	194.8	WS,FG	—	Re	—	101.0	72.0[3]	—	DB	2	229	JH	Hy	M	—	EE	2	347	JH	Hy	M	—	EE	47
CES	30.2	87.8	20.6	34.4	194.8	WS,TB	TB	Re	—	106.0	101.0[3]	40	DB	2	229	JH	Hy	M	730	EE	2	347	JH	Hy	M	1250	EE	48
CES	30.2	87.8	20.6	34.4	194.8	WS,TB	TB	Re	—	106.0	101.0[3]	40	DB	2	229	JH	Hy	M	730	EE	2	347	JH	Hy	M	1250	EE	49
BWG	41.1	66.0	31.4	20.0	194.8	WS,FG	—	Re	—	101.0	72.0[3]	—	DB	2	229	JH	Hy	M	—	EE	2	347	JH	Hy	M	—	EE	50
FWL	39.0	18.9	—	33.1	74.3	Pre	—	Re	—	67.5	15.2	—	DB	2	—	—	Hy	M	—	—	2	—	—	Hy	M	—	—	51
CE	12.4	55.6	12.8	15.3	148.6	WS,TB	WS,TB	PI	-1.0	73.5	12.8	32	DB	2	139	AB	V	M	500	GE	2	219	AB	Hy	M	800	GE	52
BW	23.7	52.2	14.5	7.8	102.4	—	—	Re	—	29.3	35.0	—[1]	ST	2	—	—	S,Hy	M,Du	—	—	—	—	—	—	—	—	—	53
CE	15.8	45.2	8.7	6.0	43.7	WS,TB	WS,TB	PI	9	—	30.0	36	—[4]	2	102	AB	S,Ma	M	600	EM	N	—	—	—	—	—	—	54
CES	8.5	15.8	—	12.5	90.0	WS,TB	—	Tu	5.2	31.0	17.6	4	DB[4]	2	61.5	CSL	D,Hy	M	200	CGE	2	108	—	Hy	M	300	—	55
RS	32.3	4.0	—	—	24.7	WS	—	Re	16.8	18.5	28.4	6	—[4]	2	71	SW	D	M	350	WE	N	—	—	—	—	—	—	56
RS	16.6	8.8	—	—	12.8	WS	—	Re	9.3	8.4	19.2	4	—[4]	1	41	SW	V	M	125	EL	N	—	—	—	—	—	—	57
BW	8.2	3.6	—	20.9	69.4	WS	—	Re	12	43.9	18.5	9	—[4]	2	400[7]	GF	V,Hy	M	—	GE	N	—	—	—	—	—	—	58
RS	32.3	4.0	—	—	34.2	WS	—	Re	12	18.5	28.4	6	—[4]	1	142	SW	S,V	Mp	700	GE	N	—	—	—	—	—	—	59
BW	9.8	—	—	—	84.4	FG	—	—	0.05	33.8	105[3]	9	—	2	394[7]	SW	—	M	250	WE	2	425[7]	SW	Hy	—	350	WE	60
BW	14.8	5.3	—	—	32.0	WS	—	Tu	—	8.5	—	—	—	1	—	—	V	Du	—	—	1	—	—	V	Du	—	—	61

BWG - Babcock-Wilcox & Goldie-McCulloch Ltd
CB - Chain Belt Co
CBF - Canadian Blower & Forge Co Ltd
CE - Combustion Engineering Inc
CEC - Continental Electric Co, Inc
CES - Combustion Engineering-Superheater Ltd
CF - Clarage Fan Co
CFB - C F Braun Co
CGE - Canadian General Electric Co, Ltd
CH - Chicago Heater Co
CHW - C H Wheeler Mfg Co
CIR - Canadian Ingersoll-Rand Co Ltd
COC - Cochrane Corp
CON - Continental Gin Co
CP - C A Parsons & Co, Ltd
CSL - Canadian Sirocco Co Ltd
CSM - Colby Steel & Mfg Co, Inc
CV - Copes-Vulcan Div, Blaw-Knox Co
DE - Davis Engineering Corp
DH - Diamond & Hopkinson
DL - DeLaval Steam Turbine Co
DP - Diamond Power Specialty Corp
DR - Dravo Corp
DS - Diamond Specialty, Ltd
DSC - Detroit Stoker Co
EC - Erie City Iron Works
EE - English Electric Co Ltd
EL - Elliott Co
EM - Electric Machinery Mfg Co
EU - Euclid Div, General Motors Corp
FA - Fly Ash Arrestor Corp
FE - Fairfield Engineering Co
FM - Fairbanks, Morse & Co
FM - Foster Wheeler Corp
FWL - Foster Wheeler Ltd
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GJW - G & J Weir, Ltd
GPL - General Precision Laboratories, Inc
GR - Griscom-Russell Co
GW - Graver Water Conditioning Co
HA - Harland Engineering
HCC - Hagan Chemicals & Controls, Inc
HCE - Hoffman Combustion Engineering Co
HE - Hack Engineering Co
HP - Heyl & Patterson, Inc
HR - Hewitt-Robins Inc Inc
HT - Hungerford & Terry, Inc
IB - Industrial Brownhoist Corp
IN - Infilco, Inc
IR - Ingersoll-Rand Co
IW - Illinois Water Treatment Co
JH - James Howden & Co (Canada)
JI - John Inglis Co Ltd
KC - Koppers Co, Inc
LA - L-A Water Softener Co
LB - Link-Belt Co
LBL - Link Belt Ltd
LC - The Lummus Co, Heat Exchanger Div
LD - Lanes Dynamo & Crypto
LDC - Lancashire Dynamo & Crypto Ltd
LN - Leeds & Northrup Co
LS - Laclede Stoker Co
ML - Montreal Locomotive Works Ltd
MS - Maryland Shipbuilding & Drydock Co

Central-station installations TABLE 1 continued

Project No.	BOILER FEED PUMPS: Capacity each, gpm	Discharge pressure psia	Manufacturer	Flow control	Drive	Drive hp	Drive manufacturer	FUELS: Fuel type	Heating value, 1000 Btu/lb	Ash fusion temp, F	Fuel delivery method	Coal unloading system	Unloading system mfr	Handling system to storage	Handling system mfr	FIRING: Coal firing equipment	Firing equipment mfr.	No. pulverizers per boiler	Ash-handling system	Ash-handling system mfr	Soot blowing type	Soot blowing medium	Soot blower mfr.	Dust collector type	Dust collector mfr.	Stack height, ft.
1	1140	7320[18]	DL	R	2M	2500	GE	C	13.2	2100	RR	CS	HR	Co	CB	P	CE	4	Pn,Hyd	UC	Ro,Ret	Air	DP	Me	PD	151
2	1400	2900	PP	R	3M	3000	AC	C	10.7	2100	Sh	SU	—	Bu	HR	P	BW	6	Hyd	—	Ro,Ret	Air	DP	EI	KC	350
3	1670	3570	WO	Hy	2M	4000	WE	C	13.3	2000	RR	Dump	HP	Co,Bu	LB	P	CE	4	Pn	ASH	Ro,Ret	Air	CV	Me,EI	BU	400
4	3100	2900	WO	Ed	2T	—15	GE	C	11.0	2000	RR	Dump	LB	Co,Bu	LB	P	CE	4	Pn,Hyd	ASH	Ro,Ret	St	DP	EI	RC	400
5	3100	2900	WO	Ed	2T	—15	GE	C	11.0	2000	RR	Dump	LB	Co,Bu	LB	P	CE	4	Pn,Hyd	ASH	Ro,Ret	St	DP	EI	RC	400
6	2380	2550	IR	Hy	2M	3000	WE	C	13.2	2200	Ba	CT	—	Co	—	P	CE	4	Pn,Hyd	—	Ro,Ret	Air	CV	Me,EI	RC	350
7	2020	6300[18]	BJ	Hy	3M	3650	GE	O	18.1	—	—	—	—	—	—	—	—	—	—	—	Ret	St	DP	Me	PD	254
8	4000	2500	WO	Hy	1M,1T[20]	3000,7500	GE	G	1040[21]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	164
9	5450	2835	WO	S	1M[22],1T	8800	GE	C	11.4	2100	Ba	CT	—	Co	—	P	FW	3	Hyd	—	Ro,Ret	—	—	EI	WP	—
10	1012	2526	AC	Hy	2M	1750	EL	G,O	1097[21]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11	1012	2026	AC	Hy	2M	1750	EL	G,O	1097[21]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
12	1000	2000	WO	R	2M	1750	WE	G,O	1100[21]	—	Pl,RR,Tr	—	—	—	—	—	—	—	—	—	Ret	St	CV	—	—	—
13	1100	2175	PP	R	2M	1750	GE	G,O	1038[21]	—	Pl,RR,Tr	—	—	—	—	—	—	—	—	—	N	—	—	N	—	133
14	1550	2400	PP	Hy	2M	2500	AC	G,O	1070[21]	—	Pl,RR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	166
15	1555	2236	BJ	R	3M	2500	GE	C	11.8	2150	Ba,RR	CS,CT	DR,HR	Co,Bu	HR	P	BW	5	Pn,Hyd	ASH	Ret	St	DP	Me,EI	WP	292
16	1450	2400	IR	R	2M	2500	GE	G,O	1060[21]	—	Pl,RR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
17	1450	2400	IR	R	2M	2500	WE	G,O	1060[21]	—	Pl,RR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
18	590[25]	2190	IR	R	2M	2250	WE	G,O	1035[21]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	117
19	1500	2203	WO	R	3M	2500	EM	C,G	10.4	1990	Ba,Pl	Cr	AH	Sc	EU	P	BW	4	Hyd	ASH	Ret	St	DP	EI	RC	294
20	—	2250	IR	S,Hy	2M	1750	WE	C,O	12.3	—[26]	RR	—	—	Co,Bu	—	Cy	BW	—	Hyd	—	—	St	DP	EI	TH	225
21	1550	2310	AC	R	2M	2500	WE	C	11.7	2050	Ba,RR	CS,CT	—	Co,Bu	CON	Cy	BW	—	Pn,Hyd	—	—	St	—	EI	RC	120
22	875	1835	IR	R	3M	1250	—	C	11.0	1950	RR	CS	RM	Co	LB	P	CE	4	Hyd	UC	Ro,Ret	Air	DP	Me	WP	250
23	—	—	—	—	—	—	—	C,G	10.6	1950	RR,Pl	CS	HR	Co	BS	P	CE	2	—	—	—	St	—	—	—	—
24	750	1768	DL	R	2M	1000	EL	C	13.2	2490	RR	CS	—	Co	FE	Cy	BW	—	Hyd	ASH	Sta	Air	DP	EI	RC	—
25	800	1980	IR	Hy	2M	1250	GE	G	1050[21]	—	Pl	—	—	—	—	—	—	—	—	—	—	—	—	—	—	150
26	688	1800	AC	R	2M	1000	AC	G	1090[21]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	121
27	585	1880	AC	R	3M	1500	GE	L	9.5	2050	RR	CS	SA	Co,Bu	SA	P	RS	4	Pn	ASH	Ro,Ret	—	CV	Me	AT	300
28	600	1700	AC	R	3M	—	WE	C	11.6	2200	Co	—	—	Co	HR	P	RS	3	Pn	UC	Ro,Ret	Air	DP	Me	WP	200
29	1340	1700	AC	R	2.5M	1500	AC	O[28]	16.5	—	—35	—	—	—	—	—	—	—	—	—	—	—	CV	—	—	175
30	1340	1700	AC	R	2.5M	1500	AC	O[28]	16.5	—	—35	—	—	—	—	—	—	—	—	—	—	—	CV	—	—	175
31	1100	1740	PP	R	2M	1500	AC	G	1040[21]	—	Pl	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
32	1686	1989	WO	S,Hy	2M	2000	WE	G	1000[23]	—	Pl	—	—	—	—	—	—	—	—	—	—	—	—	—	—	70
33	1375	2000	AC	Hy	2M	2000	AC	C	11.2	1900	RR	—	—	—	—	P	CE	3	Hyd	—	Sta,Ret	St	DP	—	—	75
34	1100	1600	IR	R	2M	1500	GE	C	10.4	1900	RR	CS	—	Co,Bu	—	Cy	BW	—	Hyd	—	Ret	St	DP	—	—	158
35	460[25]	1484	PP	Hy	2M	1000	WE	G	1000[21]	—	Pl	—	—	—	—	—	—	—	—	—	—	St	DP	—	—	—
36	—	—	AC	—	—	—	AC	G,O	1090[21]	—	Pl,Tr	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
37	—	—	—	R	—	—	—	C	—	—	—	—	—	—	—	P	RS	2	Pn	—	Ro,Ret	St	—	Me	—	—
38	450	1100	IR	R	2M	450	AC	G	1000[21]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
39	—	—	—	R	2M,2T	—	—	G,O	1000[21]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
40	—	—	—	R	2M,2T	—	—	G,O	1000[21]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
41	—	—	—	R	1M,1T	—	—	C,O,G	11.3	2030	—	—	—	—	—	P	—	—	—	—	—	—	—	Me	—	—
42	250	825	GJW	—	2M,1T	250	LDC	C	13.0	1950	RR	CS	HR	Co	SA	P	FWL	2	Hyd	ASH	Ro,Ret	St	DS	Me	PD	—
43	—	—	—	—	—	—	—	C,G,Bk		2600	RR	—	RHB	—	RHB	P	—	—	Pn	UC	—	St	DP	Me	TCC	—
	MUNICIPAL, FEDERAL AND COOPERATIVE INSTALLATIONS																									
44	4000	2742	IR	S	2M,2T	10,000	GE	C	11.6	1950	RR,Tr	Dump	LB	Co,Bu	LB	P	CE	10	Hyd	—	Ro,Ret	St	DP	EI	WP	500
45	2400	2765	HA	Hy	3M	5000	WE	C	13.2	2100	Sh	SU	—	TS	—	P	BWG	6	Pn,Hyd	—	Ret	St	CV	Me,EI	TCC	—
46	2400	2765	HA	Hy	3M	5000	WE	C	13.2	2100	Sh	SU	—	TS	—	P	BWG	6	Pn,Hyd	—	Ret	St	CV	Me,EI	TCC	—
47	735[25]	—	CIR	Hy	3M	—	BT	C	13.5	2100	Sh	—	—	—	—	P	BWG	6	—	—	Ro,Ret	St	DS	Me,EI	—	200
48	735[25]	5762	GJW	Hy	3M	3000	MV	C	13.5	2100	Sh	SU	—	Co	LBL	P	CES	5	Pn,Hyd	TEL	Ret	St	DS	Me,EI	TCC	350
49	735[25]	5762	GJW	Hy	3M	3000	MV	C	13.5	2100	Sh	SU	—	Co	LBL	P	CES	5	Pn,Hyd	TEL	Ret	St	DS	Me,EI	TCC	350
50	—	—	HA	Hy	3M	—	HA	C	13.5	2100	Sh	—	—	—	—	P	BWG	6	—	—	—	—	—	Me,EI	—	—
51	—	—	—	Hy	2M	—	—	C	13.2	2100	Ba	Cr	—	Co	—	P	FWL	4	—	—	—	—	—	—	—	350
52	850	2500	PP	Hy	3M	1750	EL	G,O	950[21]	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	160
53	—	—	—	Hy	3M	—	—	C,G	11.5	2030	—	—	—	—	—	Cy	BW	—	—	—	—	—	—	—	—	—
54	850	5500[18]	BJ	Hy	2M	1750	GE	O	18.5	—	—	—	—	—	—	—	—	—	—	—	Ret	Air	CV	—	—	—
55	—	1750	—	—	3M	—	—	O,C	17.9	—	Pl,RR	Dump	—	—	—	P	CES	3	—	—	Ret	St	DP	Me,EI	—	100
56	935	1577	PP	R	2M	1000	EL	O,G	18.2	—	Tr	—	—	—	—	—	—	—	—	—	Ret	St	CV	Me	GF	110
57	304	1520	IR	R	2M	400	WE	O	18.5	—	Sh	—	—	—	—	—	—	—	—	—	Ro,Ret	St	DP	—	—	160
58	745	1550	—	R	3M	—	—	C	12.3	2050	Ba,RR	CS	—	Co	FE	P	BW	3	Hyd	—	Ret	St	DP	Me	PD	—
59	512	1545	BJ	R	3M	600	GE	O,G	18.2	—	Tr,Pl	—	—	—	—	—	—	—	—	—	Ro,Ret	St	DP	Me	GF	90
60	1440	1500	BJ	—	2M	1750	EL	O	18.3	—	—	—	—	—	—	—	—	—	—	—	Ret	—	DP	Me	FA	128
61	—	—	—	R	—	—	—	O	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	PD	—

MANUFACTURERS (Continued)

MV - Metropolitan-Vickers Electrical Co Ltd
NA - National Aluminate Corp
NC - National Conveyor & Supply Co
PD - Pratt-Daniel Corp
PM - The Permutit Co
PP - Pacific Pumps, Inc
RC - Research-Cottrell, Inc
RF - Republic Flow Meters Co
RHB - R H Baumont
RHE - Ross Heat Exchanger Div
RM - Robbins & Myers Inc
RS - Riley Stoker Corp
SA - Stephens-Adamson Mfg Co
SB - Sulzer Brothers Ltd
SE - Southwestern Engineering Co
SP - Springfield Boiler Co
SW - Sturtevant Div, Westinghouse Electric Corp
TCC - T C Chown Ltd
TE - Terry Steam Turbine Co
TEL - Taylor Engineering Co Ltd
TH - Thermix Corp
UC - United Conveyor Co
UCP - United Centrifugal Pumps
VO - Henry Vogt Machine Co
WC - Water Conditioning, Inc
WE - Westinghouse Electric Corp
WEB - Webster Engineering Co
WF - Western Filter Co
WM - Whitlock Manufacturing Co
WO - Worthington Corp
WP - Western Precipitation Corp
YU - Yuba Heat Transfer Div

SYMBOLS USED ABOVE

Ad - Admiralty
AdBrl - Inhibited Admiralty Brass
AdD - Admiralty D
AdI - Admiralty, Inhibited
Air - Air
AlBr - Aluminum Brass
AnAd - Antimonial Admiralty
AnAdI - Antimonial Admiralty, Inhibited
AsAd - Arsenical Admiralty
AsCu - Arsenical Copper
Ba - Barge
Bk - Bark
Br - Brass
Bu - Bulldozer
C - Coal, Bituminous
CC - Cross compound
CG - Chain grate stoker
CNi - Cupro Nickel
Co - Conveyor
Cr - Crane
CS - Car shaker
CT - Coal tower
Cu - Copper
Cy - Cyclone furnace
De - Demineralizer
Dump - Dumper
Dur - Durenze IV
Ed - Eddy current coupling
El - Electrostatic
Ev - Evaporator
G - Gas

TABLE 2

HEATER					CONDENSER								TURBINES										CONTROLS					
Number	Hi-press heater exit temp, F.	Max deaerating press, psia	Manufacturer	Deaeration	Surface, 1000 sq ft	No. water passes	Tube material	Air removal	Manufacturer	Feedwater treatment (raw water)	Feedwater pH	System manufacturer	Number	Capability, each, 1000 kw	Generator cooling	Turbine type	Manufacturer	Exhaust pressure, psia	No. of bleedpoints	No. main turbine exhausts	Main generator voltage, kv	Generator rating, 1000 kva (mva)	Combustion control mfr	Feedwater control mfr	Closed-circuit TV mfr	Total boiler capacity incl. new units, 1000 lb per hr	Total generator capability incl. new units, 1000 kw	Project No.
7	505	90.8	CFB	H	95	1	Ad	—	FW	De	—	—	1	127	TC	GE	0.5	7	3	16	173	H_2	BM	BM	DP	2140	278	1
8	530	—	CFB	Hot	115	1	Ad I	Ro	FW	De	9.0	COC	1[36]	265	CC	WE	0.5	8	4	16	320	H_2,HC	RF	CV	—	3500	500	2
7	519	155	GR	H,Hot	80	1	Ad	RP	IR	De	8.8	IW	1[17]	165	CC	GE	0.5	7	1	13.8	202	H_2	LN	SB	—	1150	165	3
10[19]	511	93	GR	H,Hot	110	2	AsAd	RP	WO	De	8	GW	1[17]	175	CC	GE	1.75	7	1	13.8	230	H_2	BM	BM	DP	1300	175	4
10[19]	511	93	GR	H,Hot	110	2	AsAd	RP	WO	De	8	GW	1[17]	175	CC	GE	1.75	7	1	13.8	230	H_2	BM	BM	DP	2600	350	5
6	499	—	GR	Hot	70	1	AlBr	J,Ro	CHW	So,Ev	8.9	—	1	150	TC	GE	0.75	6	1	18	175	H_2,Li	BM	BM	—	1150	150	6
7	—	—	YU	H	110	1	AlBr	Ro	FW	De	—	—	1[16]	240	TC	WE	1.25	7	1	22	265	H_2	BM	BM	—	1550	240	7
7	474	—	—	Hot	110	1	—	Ro	RHE	De	—	—	1[16]	223	TC	GE	1.5	7	3	18	265	H_2,HC,Li	—	—	—	1650	223	8
6	480	128	—	H,Hot	140	1	Ad	J	IR	—	—	—	1[17]	300	CC	WE	0.75	6	2	18	207/176	H_2,HC	—	—	—	6000	900	9
5	462	100	GR	H	65	2	AsCu	J	WO	De	—	—	1[16]	110	TC	WE	1.75	5	1	13.8	134	H_2	BM	BM	—	800	110	10
5	462	100	GR	H	65	2	AsCu	J	WO	De	—	—	1[16]	110	TC	WE	1.75	5	1	13.8	134	H_2	BM	BM	—	1600	220	11
5	457	70	CFB,GR,PM	H,Hot	42.5	2	Ad	Ro	AC	De	—	LA	1	66	TC	GE	1.0	5	1	13.8	76.8	H_2	BM	BM	DP	900	132	12
5	466	70	—	H	42.5	2	Ad	Ro	IR	De	—	—	1[16]	68	TC	GE	1.0	5[23]	1	13.8	76.8	H_2	—	—	—	475	68	13
6	473	138	GR	H	70	1	Ad	Ro	FW	So,Ev	—	—	1[16]	156	TC	WE	1.75		1	18.0	201	H_2	—	—	—	2400	350	14
6	457	115	YU	H	105	2	Stw	J	WE	Ev	8.5	—	1	182	TC	WE	0.75	6	3	18.0	201	H_2	HCC	BM	—	3895	500	15
6	450	—	AP	Hot	100	2	AdBrI	J	CHW	So,De	8.5	PM	1[16]	169	TC	GE	1.0	5	2	18.0	192	H_2	BM	BM	—	2700	396	16
6	472	—	AP	—	100	2	—	J	CHW	So,De	8.5	PM	1[16]	170	TC	WE	1.0	5	2	18.0	211	H_2	BM	BM	—	1172	170	17
6	447	132	YU	H	85	2	Ad I	Ro	FW	De	8.0	—	1[16]	160	TC	WE	1.25	6	2	16.0	160	H_2	BM	BM	—	1020	160	18
6	463	112	—	H	100	2	PAd	J	CHW	So,Ev	—	—	1	156	TC	AC	0.75	6	1	18.0	192	H_2	BM	BM	—	3500	465	19
6	468	85	—	H	75	2	—	J	WE	De	—	—	1[29]	125	TC	WE	0.5	6	—	14.4	134	H_2	—	—	—	815	125	20
6	480	—	—	Hot	90	1	CNi	J	WE	De	8.7	—	1[27]	161	TC	GE	0.75	6	1	18.0	175	H_2	—	—	—	3150	456	21
5	451	89	—	H,Hot	50	2	Dur	J	YU	So,Ev	8	PM	1	105	TC	GE	0.75	5	2	13.8	107	H_2	LN	—	—	3292	370	22
—	—	—	—	—	—	—	—	—	—	De	—	—	1	55	TC	WE	1.0	5	2	13.8	64	H_2	—	—	—	1285	143	23
6	454	83	LC	H	43	1	Ad	J	FW	De	8.5	PM	1	79	TC	GE	0.75	5	2	13.8	96	H_2	RF	BM	GPL	3850	265	24
5	458	85	EL,AP	H	65	2	AsAd	Ro	AC	De	8.5	—	1[27]	110	TC	WE	0.75	5	2	13.8	134	H_2	—	—	—	1430	185	25
5	381	74	CFB	H	43	2	AsAd	J,RP	WE	So,Ev	8.0	AC	1	82.5	TC	AC	0.75	5	1	13.8	96	H_2	BM	—	—	567	82.5	26
11	505	39	LC	H	45	1	PAd	J	LC	So,Ev	10.5	HT	1	110	TC	WE	1.25	8	1	15.5	147	—	BM	BM	GE	1780	240	27
5	420	62	—	H	23	2	PAd	J	WE	So,Ev	10.5	WF	1[27]	44	TC	WE	0.75	5	2	13.8	—	H_2	BM	BM	—	640	66	28
6	455	70	—	H	65	2	AlBr	J	YU	De	—	—	1[16]	90	TC	GE	0.5	6	2	13.8	110	H_2	BM	BM	—	650	90	29
6	455	70	—	H	65	2	AlBr	J	YU	De	—	—	1[16]	90	TC	GE	0.5	6	2	13.8	110	H_2	BM	BM	—	1300	180	30
4	372	80	GR	H	70	2	Ad I	J	AC	De	—	—	1	100	TC	GE	1.75	5	1	15.5	147	H_2	—	RF	—	1516	162.5	31
5	451	63	GR	H	75	2	AsAd	J	AC	So,Ev	8.8	AC	1[27]	100	TC	GE	0.75	5	2	13.8	134	H_2	BM	BM	—	800	112.5	32
5	446	73	AP	H	45	2	Ad I	J	AC	De	—	PM	1	75	TC	AC	0.75	5	1	13.8	96	H_2,HC	BM	BM	DP	1200	135	33
5	430	—	—	Hot	35	2	AsAd	J	AC	Ev	—	—	1[27,29]	44	TC	GE	0.75	5	1	13.8	47	H_2	—	—	—	900	100	34
5	430	65	GR	H	35	2	Ad	J	WE	Ev	8.5	—	1[27,29]	50	TC	WE	0.75	5	1	13.8	59	H_2	BM	BM	—	425	50	35
5	—	—	—	H	—	—	—	—	AC	Ev	—	—	1[27,29]	66	TC	WE	0.75	5	1	13.8	88	H_2	—	—	—	1625	176	36
4	—	—	—	H	—	—	—	J	—	So	—	—	1[27]	15.7	SC	GE	0.75	4	1	13.8	22	H_2	BM	BM	—	220	22	37
4	351	—	GR	—	20	2	AnAd	J	CHW	De	7.9	IN	1[27]	22	SC	GE	0.75	4	1	—	27	H_2	BM	BM	—	365	35	38
—	—	100	—	H	19	2	AsCu	—	—	So	—	—	1[16]	22	SC	—	0.75	4	1	—	—	H_2	—	—	—	225	22	39
—	—	100	—	H	19	2	AsCu	—	—	So	—	—	1[16]	22	SC	—	0.75	4	1	—	—	H_2	—	—	—	450	44	40
—	—	20	—	H	24	2	AnAdI	J	—	So	—	—	1[27]	20	SC	WE	0.75	4	1	—	—	H_2	—	—	—	780	40	41
3	340	—	CP	Hot	15	2	Yo	J	CP	Ev	—	—	1[27]	18.8	SC	CP	0.5	3	1	6.6	18.8	Air	BM	BM	—	800	75	42
—	—	—	—	—	—	—	—	—	—	So	—	—	1	9.1		CP	50	—	—	—	—	Air	BM	—	—	635	—	43
8	530	150	FW	H	200	1	Ad[30]	J	YU	So,Ev	7.5	—	1[17]	500	CC	GE	0.75	8	2	24	556	HC,Li	—	—	—	9550	1250	44
7	462	115	YU,ML	H,Hot	125	1	Ad	J,Ro	FW	De	—	—	1[17]	300	CC	CP	0.5	7	4	16	353	H_2	—	—	—	2000	300	45
7	462	115	COC	H,Hot	125	1	Ad	J,Ro	FW	De	—	—	1[17]	300	CC	CP	0.5	7	3	16	353	H_2	—	—	—	4000	600	46
6	458	95	—	H	90	1	Ad	J,Ro	FW	De	—	PM	1[17,27]	200	CC	CP	0.75	6	2	13.8	235	H_2	—	BM	—	8800[31]	1200[31]	47
6	458	98	ML	H	90	1	Ad	J,Ro	FW	De	7.0	PM	1[17,27]	200	CC	CP	0.75	6	2	13.8	—	H_2	BM	BM	DH	8800[31]	1200[31]	48
6	458	98	ML	H	90	1	Ad	J,Ro	FW	De	7.0	PM	1[17,27]	200	CC	CP	0.75	6	2	13.8	—	H_2	—	BM	DH	8800[31]	1200[31]	49
—	—	95	ML	—	90	1	Ad	J,Ro	—	De	—	—	1[17]	200	—	CP	0.75	6	2	13.8	—	H_2	—	BM	—	8800[31]	1200[31]	50
—	—	—	—	—	—	1	Ad	J,Ro	—	De	—	—	1	100	TC	EE/Ji	0.5	5	3	13.8	111	H_2	—	—	—	850	100	51
5	450	100	AP,WO	H	60	2	Cu	J	FW	De	8.6	GW	1	112	—	GE	0.75	5	1	13.8	128	—	BM	BM	DP	750	100	52
—	—	—	—	H	—	—	—	J	—	So,Ev	—	—	1	100	TC	WE	0.75	5	1	—	—	H_2	—	—	—	790	100[24]	53
5	450	—	GR	Hot	50	1	CNi	J	CHW	De	11.1	PM	1[27]	90	TC	GE	0.75	5	2	12.5	79	H_2	HCC	HCC	DP	635	90	54
5	449	73	—	H	34	2	Yo	J	FWL	De	7.0	—	1	50	TC	EE	0.5	5	2	13.8	59	H_2	—	—	—	460	50	55
5	431	68	LA,SE	H,Hot	39	2	PAd	J	SE	De,So	—	WC	1[16,27]	44	TC	AC	1.0	5	2	13.8	62.5	H_2	BM	BM	—	425	44	56
4	435	130	WE	H	9	2	AlBr	J	WO	Ev	7.5	WE	1	12.5	SC	GE	0.75	4	1	13.8	16	Air	—	—	—	130	12.5	57
5	420	68	—	H	55	2	Ad0	J	YU	So,Ev	8.0	—	1[27]	66	SC	GE	0.75	5	1	13.8	70.6	H_2	—	—	—	1646	172	58
5	422	157	SE	H	38	2	AsCu	Ro	CFB	De,So	9.0	—	1[16,27]	44	TC	GE	0.75	5	2	13.8	58	H_2	BM	BM	—	1240	104	59
5	443	—	WE	H	—	2	AlBr	J	CHW	Ev	8.9	WE	1[27]	66	TC	AC	0.75	5	—	13.8	—	H_2	BM	BM	—	—	—	60
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	61

H - Heater
HC - Hollow conductor
Hot - Condenser hotwell
Hy - Hydraulic coupling
Hyd - Hydraulic
H_2 - Hydrogen
J - Steam jet
L - Lignite
Li - Liquid
M - Motor drive
Me - Mechanical
N - None
O - Oil
P - Pulverizer
PAd - Phosphorized Admiralty
Pl - Pipeline
Pn - Pneumatic
R - Regulator
Ret - Retractable
Ro - Rotary pump or blower
RP - Reciprocating pump
RR - Railroad
S - Speed control
Sc - Scraper
SC - Single cylinder
Sh - Ship
So - Softener
P - Pulverizer
St - Steam
Sta - Stationary
Ste - Stainless Steel
SU - Self unloading
T - Turbine drive
TC - Tandem compound
TG - Traveling grate stoker
TH - Track hopper
Tr - Truck
Tro - Trolley
TS - Tractor-scraper
V - Vane control
Yo - York-Albro metal
(250) - Stoker grate area, sq ft

15 - Driven on 3600 rpm shaft of main turbine; full capacity standby, 6240 hp turbine
16 - Outdoor unit
17 - Hp 3600 rpm, ip 1800 rpm
18 - Foot
19 - Three hp heaters in duplicate
20 - Main turbine
21 - Btu per cu ft
22 - Half size
23 - Five, plus one in cold reheat line
24 - Nameplate rating
25 - 1000 lb per hr
26 - Under 2500 F
27 - Preferred standard
28 - Bunker C and tar pitch
29 - Low head enclosure
30 - Admiralty, condensing section; CNi, air cooling section
31 - Ultimate total capacity
32 - Includes gas turbine capacity
33 - Btu per gallon
34 - K-F type vertical water heater
35 - Direct from refinery
36 - Hp 3600 rpm, ip 3600 rpm
37 - 16 gas & 8 coal burners

TABLE 2

1958 design survey of typical

Compiled by Althea Thornton, Assistant Editor

Project No.	Company	Location	Plant Name	Consulting Engineers	Unit No., new unit	First operation, new units	Throttle pressure, psig	Steam temperature, F		Reheat		
								Throttle	Reheat	Number	Capacity each, 1000 lb per hr
62	Corn Belt Power Cooperative	Spencer, Iowa	Earl F. Wisdom	Stanley Engineering Co.	1	1960	850	910	—	1	370
63	Eastern Iowa Light & Power Coop	Muscatine, Iowa	Montpelier	Stanley Engineering Co.	1[1]	12-59	850	900	—	1	215
64	City of Edmonton	Edmonton, Alberta	Municipal		8	8-60	850	900	—	1	660
65	City of Grand Island	Grand Island, Neb.	Bischeld St.	Lutz & May	—	5-57	850	900	—	1	165
66	Independence Power & Light Dept.	Independence, Mo.	Blue Valley	Black & Veatch	1	4-58	850	900	—	1	220
67	Independence Power & Light Dept.	Independence, Mo.	Blue Valley	Black & Veatch	2	4-58	850	900	—	1	220
68	City of Lafayette	Lafayette, La.	Municipal	Lutz & May	4	7-59	850	900	—	1	220
69	Borough of Lansdale	Lansdale, Pa.	Municipal		5	4-59	850	900	—	1[5]	150
70	City of Lubbock	Lubbock, Tex.	Plant No. 2	Nelson Miner Co	7[8]	7-58	850	900	—	1[2]	225
71	Springfield Water, Light & Power Dept.	Springfield, Ill.	Lakeside	Burns & McDonnell	6	8-60	850	900	—	1	320
72	Clarksdale Public Utilities Comm	Clarksdale, Miss.			6	1-58	625	825	—	1[2]	73
73	Colorado Ute Electric Ass'n, Inc.	Nucla, Colo.	Nucla	Laramore, Douglass & Popham Inc.	1	1-59	600	825	—	1	139
74	Colorado Ute Electric Ass'n, Inc.	Nucla, Colo.	Nucla	Laramore, Douglass & Popham Inc.	2	2-59	600	825	—	1	139
75	Colorado Ute Electric Ass'n, Inc.	Nucla, Colo.	Nucla	Laramore, Douglass & Popham Inc.	3	3-59	600	825	—	1	139
76	City of Escanaba	Escanaba, Mich.	Municipal	Black & Veatch	1	1-58	600	825	—	1	125
77	City of Escanaba	Escanaba, Mich.	Municipal	Black & Veatch	2	1-58	600	825	—	1	125
78	Town of Farmington	Farmington, N.M.	Municipal	R. W. Beck & Associates	3	7-58	600	825	—	1[2]	100
79	Greenwood Utilities	Greenwood, Miss.	Municipal	Burns & McDonnell Engrg Co	1	5-60	600	825	—	1[5]	125
80	City of Peru	Peru, Ill.	Municipal	Pfeifer & Shultz	4	9-59	600	825	—	1	90
81	Spencer Municipal Utilities	Spencer, Iowa	Spencer	Stanley Engineering Co	5	1-60	600	825	—	1	100
82	Village of Winnetka	Winnetka, Ill.	Winnetka	Sargent & Lundy	4	10-58	450	750	—	1	110
83	Walsenburg Utilities	Walsenburg, Colo.	Walsen	C. H. Guernsey Co	1	11-57	425	750	—	1	70
84	Willmar Municipal Utilities Comm	Willmar, Minn.	Municipal	Pfeifer & Shultz	4	11-56	400	750	—	—	—
85	City of Hope	Hope, Ark.	Municipal	H. E. Bovay, Jr.	1	12-57	—	—	—	1	65
86	City of Brookings	Brookings, S.D.	Municipal		—	—	250	—	—	1	30

SYMBOLS USED ABOVE

Al - Attemperator
By - Gas bypass
Coil - Cooling coils
Cool - Boiler water cooling
D - Damper
DB - Dry bottom
Du - Dual turbine and motor drive
FG - Flue gas recirculation
Hy - Hydraulic coupling
Lo - Inlet louvre
M - Motor drive
Ma - Magnetic coupling
Mp - Two motors per fan
N - None
No - Number of burners
Pl - Plate
Pre - Precondensing
Re - Regenerative
S - Speed control
ST - Slag tap
T - Turbine drive
TB - Tilting burners
Tu - Tubular
V - Vane control
WS - Water spray

1 - Revised data, previously 12-57
2 - Outdoor unit
3 - 1000 Btu per sq ft per hr
4 - Pressurized furnace
5 - Semioutdoor unit
6 - Proportional gas flow through divided superheater, reheater convection section
7 - 1000 lb per hr
8 - Turbine no. 2, boiler no. 5
9 - Revised data, previously listed 9-56
10 - Boiler operates initially at 850 psig, 900 F; serves as stand-by for sodium graphite reactor
11 - Combination gas and coal firing with spreader stoker and traveling grate
12 - Once through boiler
13 - Excess air with water spray "backup"

MANUFACTURERS

AB - American Blower Corp
AC - Allis-Chalmers Mfg Co
AH - American Hoist & Derrick Co
AP - Alco Products, Inc
AR - American Radiator and Standard Sanitary Corp
ASH - Allen-Sherman-Hoff Co
AT - Aeroiec Corp
B - Bros, Inc
BB - Brown Boveri (Canada) Ltd
BC - Beaumont Birch Co
BF - Buffalo Forge Co
BFS - B F Sturtevant Co of Canada Ltd
BJ - Byron-Jackson Pumps, Inc
BM - Bailly Meter Co
BS - C O Bartlett & Snow Co
BT - British Thompson-Houston Co, Ltd
BU - Buell Engineering Co, Inc
BW - Babcock & Wilcox Co

Design survey of experimental and

Organization	Atomic Energy Commission				Pacific Gas & Elec Co and General Electric Co	Duquesne Light Company and Atomic Energy Comm	U. S. Army Corp of Engineers
Plant name	Experimental Breeder Reactor No. 1 (EBR-1)	Boiling Reactor Experiments—2, 3, 4 (BORAX)	Experimental Boiling Water Reactor (EBWR)	Sodium Reactor Experiment (SRE)	Vallecitos Boiling Water Reactor	Shippingport (PWR)	Army Package Power Reactor (APPR-1)
Plant location	NRTS, Idaho	NRTS, Idaho	Lemont, Ill	Santa Susana Mts, Calif	Pleasanton, Calif	Shippingport, Pa	Fort Belvoir, Va
Date first critical	1951	1954	Dec 1, 1956	April 25, 1957	August 5, 1957	Dec 2, 1957	April 8, 1957
Date first full power	1951	1954	Dec 29, 1956	July 1957	Oct 24, 1957	Dec 23, 1957	April 15, 1957
Reactor type	Fast breeder	Boiling water	Boiling water	Sodium graphite	Dual-cycle BW[c]	Pressurized water	Pressurized water
Reactor builder	Argonne Natl Lab	Argonne Natl Lab	Argonne Natl Lab	Atomics International[b]	General Electric Co	Westinghouse Elec Corp	Alco Products, Inc
Reactor thermal power, mwt	1.40	15.5	20 des; 61.7 actual	20	30 des; 30 actual	236	10
Plant electrical capacity, mwe	0.15	2.0	6.25 capability	6.0 (7.5-mw turb)	5.0	68 (100-mw turb)	1.975 (2.2-mw turb)
Reactor cost (latest estimate)	—	—	—	$7,300,000	$2,500,000[d]	$59,200,000	—
Turbine-generator cost	—	—	—	$1,500,000	$ 572,000	$18,300,000	—
Total plant cost	$2,732,000	—	$4,628,000	$8,800,000	$3,072,000	$77,500,000	$4,300,000
Unit plant investment, $/kw	—	—	740	1170 @ 7.5 mw	614 @ 5 mw	1290 @ 60-mw net	2150
Unit energy cost, mills/kwhr	—	—	52 (@ 80% use factor)[a]	—	—	64	—
Moderator	None	Light water	Light water	Graphite	Light water	Light water	Light water
Coolant	Sodium-potassium	Light water	Light water	Sodium	Light water	Light water	Light water
Coolant temperature, F	442 to 600 F	419	488	500 to 960 F	545	510 to 540 F	431 to 450 F
Coolant pressure, psig	15	300	600	0	1000	1985	1185
Steam temperature, F	525 (214-F feedw)	415	479 (110-F feedw)	825	545	Saturated (344-F feed)	407 F (full load)
Steam pressure, psig	400	285	560	600	1000	870 no-load; 585 full	407 no-load; 185 full
Steam flow, lb per hr	3,630	—	60,600 design	60,000	90,000 2 30 mwt	861,000	34,070
Fuel type	90% U-235 in seed Natural-U blanket	Slightly enriched uranium	1.4% U-235	2.8% U-235	Fully-enriched uranium	90% U-235 in seed, natural-U blanket	Highly enriched UO_2
Engineers	Argonne Natl Lab	Argonne Natl Lab	Sargent & Lundy	Atomics International	Bechtel Corp	Stone & Webster E Corp Burns and Roe Inc	Stone & Webster Engrg Corp

new central-station installations

	BOILERS								FURNACE					F-D FANS							I-D FANS							
	Surface 1000 sq ft																										
Manufacturer	Boiler & Waterwall	Superheater	Reheater	Economizer	Air heater	Superheat control	Reheat control	Air heater type	Pressure, in. water	Volume, 1000 cu ft	Heat release, 1000 Btu per cu ft per hr	No. of burners	Bottom	No. per boiler	Capacity each, 1000 cfm	Manufacturer	Air flow control	Drive	Drive hp	Drive manufacturer	No. per boiler	Capacity each, 100 cfm	Manufacturer	Gas-flow control	Drive	Drive hp	Drive manufacturer	Project No
RS	—	—	—	—	—	Coil	—	Re	0.1	—	18.0	6	DB	1	105	AB	V	M	247	EM	1	163	AB	Hy	M	431	EM	62
RS	26.9	—	—	—	25.6	—	—	—	—	15.9	18.0	4	DB	1	85	GF	D	M	200	GE	1	129	CF	D,Hy	M	400	GE	63
BWG	64.7	12.6	—	—	119.4	WS	—	Re	6.6	23.7	34.3	12	—[4]	2	84	BFS	D,V	M	400	CGE	N	—	—	—	—	—	—	64
BW	—	—	—	—	—	Coil	—	Tu	—	—	—	4	—	1	—	GF	D,V	Mp	125/60	—	1	—	GF	D,V	Mp	200/100	—	65
CE	15.9	7.2	—	—	32.0	TB	—	Re	-0.15	14.7	19.4	4	DB	1	80	SW	V	M	150	WE	1	129	SW	D,Hy	M	400	WE	66
CE	15.9	7.2	—	—	32.0	TB	—	Re	-0.15	14.7	19.4	4	DB	1	80	SW	V	M	150	WE	1	129	SW	D,Hy	M	400	WE	67
CE	18.2	5.7	—	—	29.0	TB	—	Tu	8.8	8.1	36.7	4	—[4]	1	261[7]	AB	V	Mp	250/100	—	N	—	—	—	—	—	—	68
RS	19.7	—	—	—	29.5	Cool	—	Re	0.1	10.4	20.9	—	DB	—	184	SW	V	M	150	EL	1	225	SW	V	M	200	EL	69
BW	10.6	4.8	—	—	23.1	WS	—	Re	4.0	8.7	30.8	4	DB[4]	1	67	SW	V	M	400	WE	N	—	—	—	—	—	—	70
BW	12.2	13.0	—	—	47.8	Coil	—	Re	5	—	72.0[9]	2	—	1	116	SW	D	M	—	—	N	—	—	—	—	—	—	71
BW	—	—	—	—	—	Coil	—	Tu	—	—	—	—	DB	—	—	—	D	M	—	—	—	—	—	D	M	—	—	72
SP	1.5	—	—	3.1	12.7	At	—	Tu	30	—	27.0	—	—	1	65	GF	V	M	150	EL	1	253	GF	D	—	250	EL	73
SP	1.5	—	—	3.1	12.7	At	—	Tu	30	—	27.0	—	—	1	65	GF	V	M	150	EL	1	253	GF	D	—	250	EL	74
SP	1.5	—	—	3.1	12.7	At	—	Tu	30	—	27.0	—	—	1	65	GF	V	M	150	EL	1	253	GF	D	—	250	EL	75
BW	15.9	4.3	—	8.2	—	—	—	—	—	6.8	24.2	—	—	1	—	—	D,V	M	—	—	1	—	—	S,D	M	—	—	76
BW	15.9	4.3	—	8.2	—	—	—	—	—	6.8	24.2	—	—	1	—	—	D,V	M	—	—	1	—	—	S,D	M	—	—	77
CE	12.0	4.5	—	—	7.3	TB	—	Re	4.5	4.1	31.0	4	—[4]	1	41	CF	Hy	M	150	WE	N	—	—	—	—	—	—	78
EC	14.7	2.8	—	2.6	8.1	Coil	—	Tu	-0.15	6.6	23.8	4	—[11]	1	47	AB	—	M	100	WE	1	75	AB	D,Hy	M	200	WE	79
EC	11.1	0.9	—	4.3	—	Cool	—	—	-0.15	4.7	25.0	—	DB	1	36	CF	V	M	40	AC	1	63	CF	D	M	125/70	AC	80
BW	11.2	3.4	—	3.8	—	—	—	—	3.1	—	27.0	6	—	1	41	CF	Hy	M	50/15	GE	1	78	CF	Hy	—	143	GE	81
BW	12.3	2.6	—	2.7	6.5	FG	—	Tu	—	5.9	24.7	—	DB	1	—	—	V	M	—	—	1	—	—	D	M	—	—	82
SP	7.8	1.9	—	3.6	—	By	—	—	—	3.2	29.9	—	—	1	32	AB	D	M	20	EL	1	51	GF	—	M	100	EL	83
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	84
VO	—	—	—	—	—	—	—	Tu	—	—	—	—	DB	1	—	—	D	M	—	—	1	—	—	D	M	—	—	85
B	3.5	—	—	—	—	—	—	—	+2.0	0.8	50.0	1	—[4]	—	—	—	D	M	—	—	—	—	—	—	—	—	—	86

BWG - Babcock-Wilcox & Goldie-McCulloch Ltd
CB - Chain Belt Co
CBF - Canadian Blower & Forge Co Ltd
CE - Combustion Engineering Inc
CEC - Continental Electric Co, Inc
CES - Combustion Engineering-Superheater Ltd
CF - Clarage Fan Co
CFB - C F Braun Co
CGE - Canadian General Electric Co, Ltd
CH - Chicago Heater Co
CHW - C H Wheeler Mfg Co
CIR - Canadian Ingersoll-Rand Co Ltd
COC - Cochrane Corp
CON - Continental Gin Co
CP - C A Parsons & Co, Ltd
CSL - Canadian Sirocco Co Ltd
CSM - Colby Steel & Mfg Co, Inc
CV - Copes-Vulcan Div, Blaw-Knox Co
DE - Davis Engineering Corp
DH - Diamond & Hopkinson
DL - DeLaval Steam Turbine Co
DP - Diamond Power Specialty Corp
DR - Drave Corp
DS - Diamond Specialty, Ltd
DSC - Detroit Stoker Co
EC - Erie City Iron Works
EE - English Electric Co Ltd
EL - Elliott Co
EM - Electric Machinery Mfg Co
EU - Euclid Div, General Motors Corp
FA - Fly Ash Arrester Corp
FE - Fairfield Engineering Co
FM - Fairbanks, Morse & Co
FW - Foster Wheeler Corp
FWL - Foster Wheeler Ltd
GE - General Electric Co
GF - Green Fuel Economizer Co, Inc
GJW - G & J Weir, Ltd
GPL - General Precision Laboratories, Inc
GR - Griscom-Russell Co
GW - Graver Water Conditioning Co
HA - Harland Engineering
HCC - Hagan Chemicals & Controls, Inc
HCE - Hoffman Combustion Engineering Co
HE - Hack Engineering Co
HP - Heyl & Patterson, Inc
HR - Hewitt-Robins Inc Inc
HT - Hungerford & Terry, Inc
IB - Industrial Brownhoist Corp
IN - Infilco, Inc
IR - Ingersoll-Rand Co
IW - Illinois Water Treatment Co
JH - James Howden & Co (Canada)
JI - John Inglis Co Ltd
KC - Koppers Co, Inc
LA - L-A Water Softener Co
LB - Link-Belt Co
LBL - Link Belt Ltd
LC - The Lummus Co, Heat Exchanger Div
LD - Lanes Dynamo & Crypto
LDC - Lancashire Dynamo & Crypto Ltd
LN - Leeds & Northrup Co
LS - Laclede Stoker Co
ML - Montreal Locomotive Works Ltd
MS - Maryland Shipbuilding & Drydock Co

Continued on next page ▶

commercial nuclear power plants

Consolidated Edison Company of New York, Inc	Commonwealth Edison Co and Nuclear Power Group, Inc[11]	Yankee Atomic Elec Co	Power Reactor Development Company and Detroit Edison Co	Consumers Public Power District	Northern States[J] Power Company	Pacific Gas & Electric Company	Pennsylvania Power and Light Company
Indian Point Station	Dresden Nuclear Power Station	Yankee Pressurized Water Power Plant	Enrico Fermi Atomic Power Plant	Sodium Graphite Power Plant	Pathfinder	Humboldt Bay	—
Buchanan, N Y 1960 1960	Morris, Ill 1960 1960	Rowe, Mass 1960 1960	Lake Erie, nr Detroit 1960 1960	Beatrice, Nebr 1962 1962	Sioux Falls, S D 1962 1962	Eureka, Calif 1962 1962	Allentown, Pa 1963 1963
Pressurized water[9] Babcock and Wilcox Co 585	Dual-cycle boiling water General Electric Co 627.5	Pressurized water Westinghouse Elec Corp 492	Fast breeder PRDC[1] 300	Sodium graphite Atomics International 265	Boiling water[K] Allis-Chalmers Mfg Co 203[1]	Boiling water General Electric Co 171	Aqueous homogeneous Westinghouse Elec Corp 550
275[9] $38,000,000 $45,000,000[1]	180 — —	134 (145-mw turbine) $23,600,000 —	100 $34,200,000 —	75 $29,000,000 $11,300,000	62 (66-mw turbine) — —	50 to 60 — —	150 $37,000,000 $20,000,000
$90,000,000 327 10 to 12	$45,000,000 250 7.5 (Excl $15 million R&D)	$57,000,000 425 14 to 16	$67,146,000 671 —	$40,300,000 537 10 to 11	$28,800,000 465 —	$20,000,000 333 (@ 60 mw) 8.7—1st core	$57,000,000 380 —
Light water Light water 490 to 510 F	Light water Light water 547	Light water Light water 487 to 536	None Sodium 550 to 800	Graphite Sodium 500 to 925	Light water Light water 489 (big) 825 (suphtg)	Light water Light water 545	Heavy water Fuel slurry, heavy water 465 to 580
1485 1000 (332-F feed) 355	1000 541 primary 965 prim; 460 sec	1985 471 505	0 755 (400-F feed) 600	46 825 (300-F feed) 800	600 825 (300-F feed) 600	1000 545 1000	2000 444 400
1,900,000 Highly-enriched UO_2 ThO_2 blanket	$1.4x10^6$ prim; $1.2x10^6$ sec 1.5% U-235 in UO_2	1,800,000 2.6% U-235 Uranium-oxide compacts	1,000,000 25% U-235 with depleted-U blanket	730,000 2.5% U-235	600,000 1.6% U-235 for boiling 20% U-235 for suphtg	580,000 (@ 50 mw) 2% U-235	2,000,000 Max enriched UO_3 ThO_2 fertile material
Vitro Engineering Co	Bechtel Corp	Stone and Webster Engineering Corp	Commonwealth Assoc, Inc United Engrs & Const, Inc	Bechtel Corp	Pioneer Service and Engineering Co	Bechtel Corp	—

Central-station installations TABLE 2 continued

Project No.	BOILER FEED PUMPS: Capacity each, gpm	Discharge pressure, psig	Manufacturer	Flow control	Drive	Drive hp	Drive manufacturer	FUELS: Fuel type	Heating value, 1000 Btu per lb	Ash fusion temp, F	Fuel delivery method	Coal unloading system	Unloading system mfr	Handling system to storage	FIRING: Handling system mfr	Coal firing equipment	Firing equipment mfr	No. pulverizers per boiler	Ash-handling system	Ash-handling system mfr	Soot blower type	Soot blowing medium	Soot blower mfr	Dust collector type	Dust collector mfr	Stack height, ft.
62	407[25]	950	BJ	Hy	2M	700	GE	C,G	11.1	1950	RR,Pi	CS	FE	Bu,Sc	FE	P	RS	3	Pn	ASH	Ro,Ret	St	DP	Ma	HCC	50
63	565	1000	AC	R	2M	500	AC	C	11.5	1950	Ba,RR	Cr	SA	Co,Bu	SA	P	RS	2	Hyd	—	Ret	St	DP	Me	PD	53
64	718	1055	BWG	S,R	3M	600	CGE	G,O	957[21]	—	Pi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	84
65	400	1400	DL	R	1M,1T	450	—	O,G	150[33]	—	RR,Tr	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
66	560	1400	DL	R	1M	600	EL	C,O,G	11.5	2100	RR	CS	AC	Co,Bu	WEB	P	CE	2	Hyd	UC	Ro,Ret	Air	CV	Me	PD	152
67	560	1400	DL	R	1M	600	EL	C,O,G	11.5	2100	RR	CS	AC	Co,Bu	WEB	P	CE	2	Hyd	UC	Ro,Ret	Air	CV	Me	PD	152
68	475	1000	BJ	Hy	2M	400	EL	O,G	18.4	—	RR,Pi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	60
69	350	1150	BJ	R	1M,1T	350	WE	C	12.7	2900	RR	CS	LB	Co	BE	P	RS	2	Pn	ASH	Ro,Ret	—	DP	Me	PD	120
70	535	1190	BJ	R	2M	350	WE	G,O	1020[21]	—	Pi,Tr	—	—	—	—	—	—	—	—	—	—	—	—	—	—	50
71	450	1050	—	R	2M	400	—	C	11.2	1900	RR,Tr	—	—	Sc	LB	Cy	BW	—	Hy	—	Ret	St	DP	—	—	150
72	—	—	—	R	—	—	—	G,O	—	—	Pi,RR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
73	180	800	UCP	—	3M	150	CEC	C	12.9	2000	Tr	Dump	—	Tr	HE	SS(250)	HCE	—	Pn	ASH	Ret	Air	CV	—	—	100
74	180	800	UCP	—	3M	150	CEC	C	12.9	2000	Tr	Dump	—	Tr	HE	SS(250)	HCE	—	Pn	ASH	Ret	Air	CV	—	—	100
75	180	800	UCP	—	3M	150	CEC	C	12.9	2000	Tr	Dump	—	Tr	HE	SS(250)	HCE	—	Pn	ASH	Ret	Air	CV	—	—	100
76	—	—	—	R	1M	—	—	C	12.2	2300	—	—	—	—	—	TG,SS	—	—	—	—	—	—	—	—	—	—
77	—	—	—	R	1M	—	—	C	12.2	2300	—	—	—	—	—	TG,SS	—	—	—	—	—	—	—	—	—	—
78	260	750	BJ	R	2M	200	EL	G	1100[21]	—	Pi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	70
79	325	—	BJ	R	2M	200	GE	C,G	12.5	2200	RR,Pi	—	—	Co,Bu	—	SS,TG	HCE	—	Pn	ASH	Ro,Ret	St	DP	Me	PD	190
80	260	795	IR	R	1M,1T	200	AC,TE	C	11.2	2045	RR	—	—	—	—	SS(200)	HCE	—	—	—	Ro	Air	DP	Me	WP	43
81	280	90	IR	—	2M	250	WE	C,G	11.3	2000	RR,Pi	CS	NC	—	—	TG(2061)	DSC	—	—	—	—	—	DP	—	WP	—
82	—	—	—	R	—	—	—	C	11.6	2200	—	—	—	—	—	TG	—	—	Pn	—	—	—	—	—	—	—
83	150	560	IR	R	1M	100	GE	C	14.0	3000	RR,Tr	Tro	IB	Co	FE	CG(196)	LS	—	Hyd	ASH	Ro	St	CV	—	—	—
84	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
85	—	—	—	R	1M,1T	—	—	O,G	18.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
86	—	—	—	R	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

MANUFACTURERS (Continued)

MV - Metropolitan-Vickers Electrical Co Ltd
NA - National Aluminate Corp
NC - National Conveyer & Supply Co
PD - Pratt-Daniel Corp
PM - The Permutit Co
PP - Pacific Pumps, Inc
RC - Research-Cottrell, Inc
RF - Republic Flow Meters Co
RHB- R H Baumont
RHE - Ross Heat Exchanger Div
RM - Robbins & Myers Inc
RS - Riley Stoker Corp
SA - Stephens-Adamson Mfg Co
SB - Sulzer Brothers Ltd
SE - Southwestern Engineering Co
SP - Springfield Boiler Co
SW - Sturtevant Div, Westinghouse Electric Corp
TCC- T C Chown Ltd
TE - Terry Steam Turbine Co
TEL - Taylor Engineering Co Ltd
TH - Thermix Corp
UC - United Conveyor Co
UCP- United Centrifugal Pumps
VO - Henry Vogt Machine Co
WC - Water Conditioning, Inc
WE - Westinghouse Electric Corp
WEB- Webster Engineering Co
WF - Western Filter Co
WM - Whitlock Manufacturing Co
WO - Worthington Corp
WP - Western Precipitation Corp
YU - Yuba Heat Transfer Div

SYMBOLS USED ABOVE

Ad - Admiralty
AdBr - Inhibited Admiralty Brass
AdD - Admiralty D
AdI - Admiralty, Inhibited
Air - Air
AlBr - Aluminum Brass
AnAd - Antimonial Admiralty
AnAdI - Antimonial Admiralty, Inhibited
AsAd - Arsenical Admiralty
AsCu - Arsenical Copper
Ba - Barge
Bk - Bark
Br - Brass
Bu - Bulldozer
C - Coal, Bituminous
CC - Cross compound
CG - Chain grate stoker
CNi - Cupro Nickel
Co - Conveyor
Cr - Crane
CS - Car shaker
CT - Coal tower
Cu - Copper
Cy - Cyclone furnace
De - Demineralizer
Dump - Dumper
Dur - Duronze IV
Ed - Eddy current coupling
El - Electrostatic
Ev - Evaporator
G - Gas

Design survey of experimental and commercial

Organization	Florida West Coast and East Central Nuclear Groups[m]	Rural Cooperative Power Association	Carolinas-Virginia Nuclear Power Associates, Inc	City of Piqua, Ohio	Chugach Electric Association	Atomic Energy Commission	
Plant name	-----	Elk River Boiling Reactor	-----	Municipal plant	Chugach Power Plant	Experimental Breeder Reactor No. 2 (EBR-2)	Homogeneous Reactor Experiment No. 2 (HRE-2)
Plant location	Florida west coast	Elk River, Minn.	Parr Shoals, S C	Piqua, Ohio	Anchorage, Alaska	NRTS, Idaho	Oak Ridge, Tenn
Date first critical	1963	1960	1962	1961	1962	1960	1957--delayed by corrosion problems
Date first full power	1963	1960	1962	1961	1962	1960	
Reactor type	Gas cooled, D_2O moderated	Boiling water[n]	PWR, pressure tube	Organic moderated	Sodium--heavy water	Fast, enriched U-Pu	Enriched U, homogeneous
Reactor builder	General Nuclear Engrg Corp	ACF Industries, Inc	Westinghouse Elec Corp	Atomics Internatl Div	Nuclear Develop Corp of Amer	Argonne Natl Lab	Oak Ridge Natl Lab
Reactor thermal power, mwt	173	73	60.5	45.5	40	62.5	5.0
Plant electric capacity, mwe	46 (50-mw turbine)	22	17.0	11.4	10	20	0.3 (existing gen)
Reactor cost (latest estimate)	-----	-----	-----	$12,300,000	$5,500,000	-----	-----
Turbine-generator cost	-----	$1,800,000	-----	$ 4,000,000	$1,800,000	-----	-----
Total plant cost	$34,900,000	$13,300,000	$36,700,000	$16,300,000	$7,300,000	$29,100,000	$3,833,000
Unit plant investment, $/kw	759	605	2160	1430	730	1455	-----
Unit energy cost, mills/kwhr	-----	-----	-----	-----	-----	-----	-----
Moderator	Heavy water (D_2O)	Light water	Heavy water	Hydrocarbon	Heavy water	None	Heavy water
Coolant	Gas	Light water	Heavy water	Hydrocarbon	Sodium	Sodium	Fuel solution
Coolant temperature, F	1020	528 water--533 steam	550 average	617 average	650 to 950	720 to 900	493 to 572
Coolant pressure, psig	520	900	1500	50	0	100	1750 to 2000
Steam temperature, F	1000	825	725	550	850	850	471
Steam pressure, psig	1000 to 1800	600	400	450	850	1250	505
Steam flow, lb per hr	-----	225,000	203,000	150,500	-----	200,000	-----
Fuel type	Slightly enriched U	9.8% enriched UO_2 ThO_2 fertile material	2% U-235	Slightly enriched U	1.5% U-235	60% enriched U	90% enriched U-235 in UO_2SO_4--D_2O
Engineers	General Nuclear Engrg Corp	-----	Stone and Webster Engrg Corp	-----	-----		

HEATERS					CONDENSER							TURBINES									CONTROLS					
Number	Hi-press heater exit temp, F	Max. deaerating press, psia	Manufacturer	Deaeration	Surface, 1000 sq ft	No. water passes	Tube material	Air removal	Manufacturer	Feedwater treatment (raw water)	Feedwater pH	System manufacturer	Number	Capability, each, 1000 kw	Turbine type	Manufacturer	Exhaust pressure, psia	No. of bleedpoints	No. main turbine exhausts	Main generator voltage, kv	Generator rating, 1000 kva (mva)	Generator cooling	Combustion control mfr	Feedwater control mfr	Closed-circuit TV mfr	Total boiler capacity incl. new units, 1000 lb per hr	Total generator capability incl. new units, 1000 kw	Project No.
5	414	61	RHE	H,Hot	—	2	Adl	J	CHW	De,So	8.0	—	1[27]	33	SC	EL	—	5	1	13.8	—	H_2	—	—	—	370	33	62
4	355	63	RHE,CH	H	18	2	AdD	J	MS	De	8	—	1[27]	24	SC	WE	0.75	4	1	13.8	24	H_2	RF	RF	—	235	24	63
5	427	84	FWL	H	39	2	Br	J	BB	So,Ev	8.2	—	1	75	TC	BB	0.75	5	2	14.4	77.8	H_2	BM	BM	—	2140	255[32]	64
4	350	25	CH	H	—	2	Ad	J	AC	De	10.5	GW	1	20.5	SC	AC	0.75	4	—	13.8	16.5	H_2	BM	BM	—	160	16.5	65
4	338	35	COC	H	21	2	Adl	J	AC	De	7.2	GW	1[27]	22	SC	AC	0.75	4	1	—	23.5	H_2	HCC	HCC	—	220	22	66
4	338	35	COC	H	21	2	Adl	J	AC	De	7.2	GW	1[27]	22	SC	AC	0.75	4	1	—	23.5	H_2	HCC	HCC	—	440	44	67
4	350	28	RHE,GW	H	20	2	Adl	J	RHE	Ev	8.5	AP	1[27]	22	SC	GE	0.75	4	—	13.8	29.4	H_2	BM	BM	—	465	44.7	68
1[34]	350	—	COC	Hot	10	2	Ad	J	MS	So,Ev	7.0	—	1[27]	15.6	SC	WE	1.0	4	1	4.16	15.6	Air	BM	BM	—	390	24.5	69
4	340	—	WE	Hot	19	2	AsAd	J	WE	So,Ev	8.2	—	1[27]	25	SC	WE	1.25	4	1	12.5	29.4	H_2	BM	BM	—	800	83	70
5	415	66	—	H,Hot	28	2	Ad	J	YU	So,Ev	—	—	1[27]	33	—	AC	0.75	5	—	13.8	40.6	H_2	—	—	—	—	113	71
4	—	—	—	H	6	2	Cu	J	WE	—	—	—	1	6.3	—	WE	—	3	1	13.8	6.4	—	BM	CV	—	—	—	72
3	576	160	AR	H	12	2	CNi	J	MS	Ev	8.0	—	1[27]	12.7	—	DL	0.75	4	—	13.8	13.5	Air	—	—	—	139	12.7	73
3	576	160	AR	H	12	2	CNi	J	MS	Ev	8.0	—	1[27]	12.7	—	DL	0.75	4	—	13.8	13.5	Air	—	—	—	278	25.3	74
3	576	160	AR	H	12	2	CNi	J	MS	Ev	8.0	—	1[27]	12.7	—	DL	0.75	4	—	13.8	13.5	Air	—	—	—	417	38	75
—	—	45	—	H,Hot	8.5	2	Ad	J	—	De	—	—	1[27]	12.5	SC	AC	0.75	4	1	—	—	Air	—	—	—	125	12.5	76
—	—	45	—	H,Hot	8.5	2	Ad	J	—	De	—	—	1[27]	12.5	SC	AC	0.75	4	1	—	—	Air	—	—	—	250	25	77
3	366	49	CH	H	8.5	2	AsCu	J	LC	So,Ev	—	—	1	9.4	SC	WE	1.0	3	1	4.16	9.4	Air	RF	RF	GE	185	18	78
4	348	75	WM,CH	H,Hot	13.0	2	Ad	J	YU	Ev	8.1	DE	1	12.7	SC	WE	0.75	4	1	13.8	13.5	Air	BM	BM	—	140	12.7	79
3	335	38	CH,RHE	H,Hot	8.5	2	Ad	J	WO	De	—	IW	1	9.4	SC	EL	0.75	3	1	4.16	9.4	Air	BM	BM	—	230	15.3	80
1	300	216	YU	—	10.0	2	—	—	YU	—	—	—	1	7.5	SC	WO	1.0	1	—	13.8	7.5	Air	HCC	—	—	270	17.5	81
—	—	—	—	—	—	—	—	—	—	Ev	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	240	15.5	82
—	250	—	—	H	5.5	2	PAd	J	LC	So,Ev	—	NA	1	5.0	—	WE	—	—	—	—	—	—	BM	—	—	120	11	83
—	—	—	—	—	—	—	—	—	—	—	—	—	1	9.4	—	AC	1.0	2	1	7.2	9.4	—	—	—	—	185	15.3	84
—	—	35	—	H	—	—	—	—	—	De	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	85
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	100	5.3	86

N - Heater
HC - Hollow conductor
Hot - Condenser hotwell
Hy - Hydraulic coupling
Hyd - Hydraulic
H_2 - Hydrogen
J - Steam jet
L - Lignite
Li - Liquid
M - Motor drive
Me - Mechanical
N - None
O - Oil
P - Pulverizer
PAd - Phosphorized Admiralty
Pi - Pipeline
Pn - Pneumatic
R - Regulator
Ret - Retractable
Ro - Rotary pump or blower
RP - Reciprocating pump
RR - Railroad
S - Speed control
Sc - Scraper
SC - Single cylinder
Sh - Ship
So - Softener
SS - Spreader stoker
St - Steam
Sta - Stationary
Ste - Stainless Steel
SU - Self unloading
T - Turbine drive
TC - Tandem compound
TG - Traveling grate stoker
TH - Track hopper
Tr - Truck
Tro - Trolley
TS - Tractor-scraper
V - Vane control
Ye - York-Albro metal
(250) - Stoker grate area, sq ft

15 - Driven on 3600 rpm shaft of main turbine; full capacity standby, 6240 hp turbine
16 - Outdoor unit
17 - Hp 3600 rpm, lp 1800 rpm
18 - Feet
19 - Three hp heaters in duplicate
20 - Main turbine
21 - Btu per cu ft
22 - Half size
23 - Five, plus one in cold reheat line
24 - Nameplate rating
25 - 1000 lb per hr
26 - Under 2500 F
27 - Preferred standard
28 - Bunker C and tar pitch
29 - Low head enclosure
30 - Admiralty, condensing section; CNi, air cooling section
31 - Ultimate total capacity
32 - Includes gas turbine capacity
33 - Btu per gallon
34 - K-F type vertical water heater
35 - Direct from refinery
36 - Hp 3600 rpm, lp 3600 rpm
37 - 16 gas & 8 coal burners

nuclear power plants continued

Atomic Energy Commission				U S Army Corp of Engineers	Michigan Chemical Corporation	FOOTNOTES
Organic Moderated Reactor Experiment (OMRE)	Los Alamos Power Reactor Exp (LAPRE-2)	Liquid Metal Fuel Reactor Experiment (LMFRE)	Gas cooled Power Reactor	Army Package Power Reactor (APPR-1A)	Process steam reactor (proposed)	a--With 15-mw turbine-generator, costs estimated at 32 mills per kwhr
NRTS, Idaho	Los Alamos, N Mex	Not announced	Study proposed	nr Fairbanks, Alaska	St Louis, Mich	b--Southern California Edison Co supplies turbine-generator and buys energy
1957	1958	-----	Not set	1960	Not announced	c--Reactor can work as natural or forced circulation, and single or dual cycle by venting flashed steam to atmosphere
1957	1958	-----	Not set	1960	Not announced	d--Excluding land and miscellaneous items needed for a commercial plant
Organic moderated	Aqueous homogeneous L	Liquid metal fuel	Gas cooled	Pressurized water	Pressurized water	e--112 mwe supplied by an oil-fired superheater
Atomics Internati Div	Los Alamos Scien Lab	Babcock & Wilcox Co	Not selected	Alco Products, Inc	Martin Co	f--Includes $13,000,000 for an oil-fired superheater
16	1.0	20	30 to 40	20 approx	45	g--Converter changing Th-232 to U-233
0	0	0	Not selected	1.7 (10-mw heating)	None	h--Includes: American Electric Power Corp, Bechtel Corp, Central Illinois Lighting Co, Commonwealth Edison Co, Illinois Power Co, Kansas City Power & Light Co, Pacific Gas & Electric Co, Union Electric Co.
$2,531,000	$100,000	$15,000,000	-----	-----	$2,500,000	
-----	-----	-----	-----	-----	0	
-----	-----	-----	-----	-----	$2,836,000	
-----	-----	-----	-----	-----	-----	
-----	-----	-----	-----	-----	77.4¢/1000 lb steam	i--Power Reactor Development Company consisting of 6 manufacturers and 18 electric utilities
Diphenyl	Light water	Graphite	Graphite	Light water	Light water	j--With Central Atomic Power Associates consisting of 11 electric utility companies.
Diphenyl	Light water	Fuel solution	Gas	Light water	Light water	k--Controlled water circulation and oil-fired or nuclear-heated superheater
500 to 700	600 out	825-925	-----	-----	-----	l--164 mwt boiling and 39mwt for superheating
300	800	-----	-----	-----	-----	m-Florida West Coast and East Central consists of two Florida and 12 northern utility companies
None	492	-----	-----	-----	366	n-Closed cycle; oil-fired superheater for 7 mwe
None	600	-----	-----	-----	150	
None	-----	-----	-----	-----	150,000	ADPA - Atomic Power Development Associates, Inc
90% U-235	90% U-235	90% U-235	Natural U	Highly enriched U	Slightly enriched U	NRTS - National Reactor Testing Station
Atomics Internati Div	-----	-----	-----	Peter Kiewit Sons Co of Omaha	H K Ferguson Co	

1958 design survey: typical hydroelectric

Compiled by F A Annett
Contributing Editor

Project No.	Company or government agency	Design or consulting engineers	Project name	[1]New or redeveloped	River	State	Project started, year	[2]Dam, type	Crest Length, ft	Max. height, ft	[3]Type of Installation
	NEW ENGLAND STATES										
1	Citizens Utilities Co.	Citizens Utilities	Newport No. 11	Red.	Clyde	Vt.	1956	CG	90	19	I
2	Ryegate Paper Co.		East Ryegate	Red.		Vt.	1956	.....	.....	.....	I
	MIDDLE ATLANTIC STATES										
3	Power Authority of the State of N.Y.	Uhl, Hall & Rich	Barnhart Island	New	St. Lawrence	N.Y.	1954	CG	3,200	172	S
4	Power Authority of the State of N.Y.	Uhl, Hall & Rich	Lewiston	New	Niagara	N.Y.	1958	CG	3,100	126	S
5	Power Authority of the State of N.Y.	Uhl, Hall & Rich	Lewiston	New	Niagara	N.Y.	1958	.....	.....	.....	S
6	Niagara Mohawk Power Corp.	Niagara Mohawk Power Corp.	Blake Falls	New	Raquette	N.Y.	1954	C&E	600	50	I
7	Niagara Mohawk Power Corp.	Niagara Mohawk Power Corp.	Stark	New	Raquette	N.Y.	1955	C&E	235	40	I
8	Niagara Mohawk Power Corp.	Niagara Mohawk Power Corp.	Prospect	New	West Canada	N.Y.	1957	CG	270	52	I
9	Eastman Kodak Co.	Company Engineering Staff	Waste treatment	New	Genesee	N.Y.	1955	.....	10	115	I
	EAST NORTH CENTRAL STATES										
10	Northern States Power Co of Wis.	Pioneer Service & Engineering Co.	Menominee	Red.	Red Cedar	Wis.	1955	CG	.....	.....	S
11	Nekoosa-Edwards Paper Co.		Port Edwards	Red.		Wis.	1956	.....	.....	.....	I
	WEST NORTH CENTRAL STATES										
12	U. S. Army Engineers	U. S. Army Engrs; Chas T Main Inc.	Garrison	New	Missouri	N.D.	1945	EF	12,000	210	I
13	U. S. Army Engineers	U. S. Army Engrs; Chas T Main Inc.	Oahe	New	Missouri	S.D.	1948	EF	9,300	242	I
14	U. S. Army Engineers	U. S. Army Engrs; Harza Engrg Co.	Gavins Point	New	Missouri	S.D. & Neb.	1948	EF	8,700	74	I
	SOUTH ATLANTIC STATES										
15	Alexandria Water Co.		Alexandria	New		Va.	1956	.....	.....	.....	I
16	Georgia Power Co.	Georgia Power Co; Southern Services	Oliver Dam	New	Chattahoochee	Ga.	1957	CG	2,020	70	S
17	U. S. Army Engineers	U. S. Army Engrs; Harza Engrg Co.	Hartwell Dam	New	Savannah	Ga.	1955	C&E	.....	.....	O
18	U. S. Army Engineers	U. S. Army Engrs; Erik Floor & Assoc.	Fort Gaines	New	Chattahoochee	Ala. & Ga.	1955	C&E	13,570	.....	I
	EAST SOUTH CENTRAL STATES										
19	U. S. Army Engineers	U. S. Army Engineers	Barkley	New	Cumberland	Ky.	1957	.....	.....	.....	I
20	Tapoco, Inc.	Aluminum Company of America	Chilhowee	New	Little Tennessee	Tenn.	1955	EF; RF	1,410	82	I
21	U. S. Army Engineers	U. S. Army Engrs; Ambursen Engr Corp.	Old Hickory	New	Cumberland	Tenn.	1951	CG; EF	3,750	98	I
22	U. S. Army Engineers	U. S. Army Engineers	Cheatham	New	Cumberland	Tenn.	1950	CG	495	75	I
23	Alabama Power Co.	Silas H Woodard, Herbert J Scholz, George F Sowers, Byram W Steele, J P Growdon & Southern Services	Lewis Smith Dam	New	Warrior	Ala.	1957	E & RF	2,200	300	I
24	Alabama Power Co.		Weiss Dam	New	Coosa	Ala.	1958	Earth	10,000	100	I
	WEST SOUTH CENTRAL STATES										
25	U. S. Army Engineers	U. S. Army Engrs; Swerdrup & Parcel	Dardanelle	New	Dardanelle	Ark.	1957	CG	.....	.....	I
26	U. S. Army Engineers	U. S. Army Engineers	Greers Ferry	New	White	Ark.	1957	CG	.....	.....	I
27	U. S. Army Engineers	U. S. Army Engineers	Table Rock	New	White	Ark.	1952	CG; EF	6,388	250	I
28	U. S. Army Engineers	U. S. Army Engrs; Swerdrup & Parcel	Eufaula	New	Canadian	Okla.	1957	CG; EF	.....	.....	I
	MOUNTAIN STATES										
29	Washington Water Power Co.	Ebasco Services Inc.	Noxon	New	Clark Fork	Mont.	1955	CG; EF	4,700	190	O
30	Montana Power Co.	Bechtel Corp.	Cochrane	New	Missouri	Mont.	1956	CG	869	105	S
31	U. S. Army Engineers	U. S. Army Engrs; Erik Floor & Assoc.	Fort Peck No. 2	New	Missouri	Mont.	1957	Earth	21,026	250	I
32	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Helena Valley	New	Missouri	Mont.	1957	CG	1,000	225	O
33	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Glendo	New	North Platte	Wyo.	1954	EF	4,640	207	I
34	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Fremont Canyon	New	North Platte	Wyo.	1956	.....	.....	.....	I
35	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Palisades	New	Snake	Idaho	1952	EF	2,200	206	I
36	Bonners Ferry Light & Water Dept.			Red		Idaho	1957	.....	.....	.....	I
37	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Wanship	New	Weber	Utah	1956	.....	.....	.....	O
38	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Gateway	New	Weber	Utah	1956	.....	.....	.....	O
39	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Deer Creek	New	Provo	Utah	1955	EF	1,300	235	I
40	Garkane Power Association	Harza Engineering Co.	Boulder	New	Boulder Creek	Utah	1957	EF	450	30	I
41	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Glen Canyon	New	Colorado	Ariz.	1957	CA	1,500	700	I
42	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Big Thompson	New	Big Thompson	Colo.	1957	.....	.....	.....	O
43	Bd of Wr Com City & County of Denver	Tipton & Kalmbach, Inc.	Williams Fork Dam	New	Williams Fork	Colo.	1956	CA	664	214	I
	PACIFIC COAST STATES										
44	U. S. Army Engineers	U. S. Army Engineers	Chief Joseph	New	Columbia	Wash.	1949	CG	2,315	235	I
45	U. S. Army Engineers	U. S. Army Engineers	McNary	New	Columbia	Wash. & Ore.	1947	CG; EF	8,000	157	I
46	U. S. Army Engineers	U. S. Army Engineers	The Dalles	New	Columbia	Wash. & Ore.	1951	CG	.....	.....	I
			Dalles Fishway				1951		.....	.....	I
47	Public Utility Dist, Grant County	Harza Engineering Co.	Priest Rapids	New	Columbia	Wash.	1956	CG; EF	8,412	178	I
48	Public Utility Dist, Grant County	Harza Engineering Co.	Wanapum	New	Columbia	Wash.	1955	CG; EF	9,400	128	I
49	PUD No. 1 Chelan County	Stone & Webster Engineering Corp.	Rocky Reach	New	Columbia	Wash.	1956	CG	2,770	140	I
			State Fishway	New	Columbia	Wash.	1956				
50	U. S. Army Engineers	U. S. Army Engrs; Swerdrup & Parcel	Ice Harbor	New	Snake	Wash.	1956	CG	2,790	100	I
51	Seattle City Light	J L Savage Associates	Diablo	Red.	Skagit	Wash.	1956	Arch	1,180	389	I
52	Tacoma Dept of Public Util, Lt Div	Harza Engineering Co.	Mayfield	New	Cowlitz	Wash.	1955	A&G	875	245	I
53	Puget Sound Power & Light Co.	Stone & Webster Engineering Corp.	Lower Baker No. 3	New	Baker	Wash.	1957	.....	.....	.....	I
54	Puget Sound Power & Light Co.	Stone & Webster Engineering Corp.	Upper Baker	New	Baker	Wash.	1956	CG	1,200	300	I
55	Puget Sound Power & Light Co.	Stone & Webster Engineering Corp.	Snoqualmie No. 2	New	Snoqualmie	Wash.	1956	.....	.....	.....	I
56	Pacific Power & Light Co.	Bechtel Corp.	Swift No. 1	New	Lewis	Wash.	1956	Earth	2,100	512	I
57	PUD No. 1, Cowlitz County	H Zinder & Assoc; Bechtel Corp.	Swift No. 2	New	Lewis	Wash.	1957	Earth	2,100	512	I
58	Pacific Power & Light Co.	Ebasco Services Inc.	Merwin	New	Lewis	Wash.	1929	Arch	752	314	I
59	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Roza	New	Yakima	Wash.	1956	.....	.....	.....	I
60	Portland General Electric Co.	Ebasco Services Inc.	North Fork	New	Clackamas	Ore.	1956	Arch	657	206	O
61	Portland General Electric Co.	Ebasco Services Inc.	Pelton	New	Deschutes	Ore.	1956	CA	750	200	O
62	Portland General Electric Co.	Ebasco Services Inc.	Faraday	New	Clackamas	Ore.	1956	.....	.....	.....	O
63	California Oregon Power Co.	Pioneer Service & Engineering Co.	Big Bend	New	Klamath	Ore.	1956	EF	652	72	S

[1]The term "New" applies to a project on a site not developed before. "Redeveloped" indicates a project on a site that has been developed before and now has new turbines, settings, generators or a new plant.

[2]A&G, arch and gravity; CA, concrete arch; CG& EF, concrete gravity and earth fill; CG, S&B, concrete gravity, slab & buttress, CS&B, concrete slab and buttress; EF, earth fill; EF&RF, earthfaced, rock fill; EF-CW, earth fill with concrete core wall; HF, hydraulic fill; P&G piers & gates, RF, rock fill; RFCF, rock fill, concrete face; REF, rolled earth fill, SE sector gates; S&R, sluiceways and rock fill; TC timber crib.

[3]I, indoor; S, semi-outdoor; O, outdoor, U, underground.

[4]AC - Allis-Chalmers Mfg Co
AE - American Elin Corp
ASG - Ansaldo-San Giorgio
BB - Brown Boveri Corp
BL - Baldwin Lima-Hamilton Corp
CAC - Canadian Allis-Chalmers Ltd
CBS - Charles Barber & Sons
CGE - Canadian General Electric
CVL - Canadian Vickers Ltd
CWC - Canadian Westinghouse Co Ltd
DEC - Dominion Engineering Co Ltd
EC - Elliott Co
EE - English Electric Co Ltd

plants in the United States and Canada

Initial operation, year	Initial Capacity, hp	Added capacity, No. of units	Added capacity year	Ultimate capacity, hp	No. of units installed	Hydro-turbine capacity, hp	Hydro-turbine type	Speed, rpm	Static head, ft	Design head, ft	[4]Hydro-turbine manufacturer	[4]Governor manufacturer	Scroll case, concrete or steel	Penstock valve, type	Generator capacity, kva	Synchronizing, manual or automatic	Thrust-bearing location	Design power factor	Kilovolts	[4]Generator manufacturer	Project No.
1957	2,400	..	.....	2,400	1	2,400	Francis	400	59-52	57	JL	W	Concrete	Head gates	2,200	Manual	AG	0.80	4.16	GE	1
1957	430	..	.....	430	1	430	Francis	86	13	13	JL	W	Concrete	Head gates	Drives mill machinery		....	.....	.....	....	2
1958	1,280,000	..	.....	1,280,000	8	80,000	Propeller	94.7	88-79	81	AC	AC	Concrete	Head gates	60,000	Auto. or Man.	BG	0.95	13.8	GE	3
					8	80,000	Propeller	94.7	88-79	81	BL	AC	Concrete	Head gates	60,000	Auto. or Man.	BG	0.95	13.8	GE	
1961	2,600,000	..	.....	2,600,000	13	200,000	Francis	120	315-220	300	BL & NN	W	Plate steel	Head gates	167,000	Auto. or Man.	BG	0.90	13.8	WE	4
1961	336,000	..	.....	336,000	12	28,000	Francis	112.5	95-53	75	AC & MS		Concrete	Head gates	25,000	Supervisory	BG	0.80	13.8	AC	5
					These units operate in reverse as 37,500 hp, 3,400 cfs, 85-ft head pumps. Head range 99-57 ft.																
1957	18,650	..	.....	18,650	1	18,650	Francis	112.5	69	67	MS	W	Plate steel	Head gates	16,000	Automatic	BG	0.90	6.9	AC	6
1957	32,000	..	.....	32,000	1	32,000	Francis	120	125	104	MS	W	Plate steel	Head gates	25,000	Automatic	BG	0.90	11.5	GE	7
1959	23,900	..	.....	23,900	1	23,900	Francis	180	137-132	136	JL	W	Plate steel	Head gates	19,250	Automatic	BG	0.90	6.9	GE	8
1957	686	..	.....	686	1	686	Francis	900	115	115	JL	W	Bronze	Butterfly	690	Automatic	HS	0.90	0.44	EC	9
1958	7,500	..	.....	7,500	2	3,750	Kaplan	180	33-21	30	MS	W	Concrete	Head gates	3,000	Manual	AG	0.80	4.16	EM	10
1957	1,700	..	.....	1,700	2	850	Francis	225	16	16	JL		Concrete	Head gates	Connects to existing generator		.....	.....	.....	...	11
1955	264,000	2	59-60	440,000	5	88,000	Francis	90	187-100	150	BL	W	Plate steel	Head gates	84,210	Manual	BG	0.95	13.8	GE	12
1961	899,000	..	.....	899,500	7	128,500	Francis	100	210-130	185	AC		Plate steel	Head gates		Manual	BG	0.95	13.8	....	13
1956	162,000	2	1957	162,000	3	54,000	Kaplan	75	66-40	48	BL	W	Concrete	Head gates	35,100	Manual	BG	0.95	13.8	GE	14
1957	1,776	..	.....	1,776	2	888	Francis	450	64	64	JL		Concrete	Head gates	635	Manual	AG	.....	4.16	GE	15
1959	84,100	..	.....	84,100	3	25,200	Propeller	150	65-68	67	NN	W	Concrete	Head gates	22,500	Automatic	BG	0.80	7.6	WE	16
					1	8,500	Propeller	257	65-68	67	NN	W	Concrete	Head gates	7,500	Automatic	BG	0.80	7.6	WE	
1963	366,000	..	.....	457,500	4	91,500	Francis	100	183-144	70			Plate steel	Head gates	73,333	Auto. or Man.	BG	0.90	13.8	....	17
1962	182,000	..	.....	182,000	4	45,500	Kaplan	112.5	88-38	70	NN		Concrete	Head gates	36,111	Auto. or Man.	BG	0.90	13.8	EC	18
1962	232,000	..	.....	232,000	4	58,000	Kaplan	65.5	72-18	44	NN		Concrete	Head gates	36,111	.....	BG	0.90	13.8	....	19
1957	70,000	..	.....	70,000	3	23,333	Kaplan	128.6	64-50	56.5	NN	W	Concrete	Head gates	19,610	Auto. or Man.	BG	0.85	6.9	WE	20
1956	180,000	2	1957	180,000	4	45,000	Kaplan	75	60-25	45	BL	W	Concrete	Head gates	31,250	Manual	BG	0.80	13.8	GE	21
1958	60,000	..	.....	60,000	3	20,000	Kaplan	60	32	32	NN	W	Concrete	Head gates	13,333	Manual	BG	0.90	13.8	WE	22
1961	111,500	..	.....	223,000	1	111,500	Francis	138.5	255-233	210	AC	AC	Welded pl st	Head gates	87,500	Automatic	BG	0.90	13.8	GE	23
1961	78,200	..	.....	117,300	2	39,100	Propeller	90	59-53	49	AC	W	Concrete	Head gates	32,500	Manual	BG	0.90	13.8	WE	24
1964	167,000	..	.....	167,000	4	41,750	Kaplan	75	55-20	43			Concrete	Head gates	31,579	.....	BG	0.95	13.8	....	25
1962	132,600	..	.....	132,600	2	66,300	Francis	120	214-161	175	....	....	Plate steel	Head gates	50,526	.....	BG	0.95	13.8	....	26
1958	138,000	..	.....	274,000	4	68,000	Francis	128.6	228-134	190	EE	W	Plate steel	Head gates	52,623	Manual	BG	0.95	13.8	WE	27
					2	1,000	Francis	600	228-134	190	JL	W	Plate steel	Head gates	875	Manual	AG	0.80	0.48	WE	
1964	138,000	..	.....	138,000	3	46,000	Francis	94.7	112-88	103	....	....	Plate steel	Head gates	35,000	.....	BG	0.95	13.8	....	28
1959	550,000	..	.....	550,000	4	137,500	Francis	100	162-154	152	AC	AC	Plate steel	Head gates	101,660	Manual	BG	0.95	14.4	GE	29
1958	84,000	..	.....	84,000	2	42,000	Kaplan	128.6	88-63	80	MS	W	Welded pl st	Head gates	30,000	Automatic	BG	0.80	13.8	WE	30
1961	127,000	..	.....	127,000	2	63,500	Francis	128.6	210-115	170	AC	....	Plate steel	Butterfly	42,105	Automatic	BG	0.95	13.8	EC	31
1959	6,400	..	.....	6,400	2	3,200	Francis	325	150-73	120	JL	....	Welded pl st	Butterfly	Drives 67,500 gpm. C H Wheeler pumps			.....	.....	....	32
1961	33,500	..	.....	33,500	2	16,750	Francis	180	135-67	107	MS	....	Plate steel	Butterfly	13,333	Manual	AG	0.90	6.9	AE	33
1960	67,000	..	.....	67,000	2	33,500	Francis	257	364-240	257	NN	W	Plate steel	Butterfly	25,263	Manual	AG	0.95	11.5	GE	34
1957	158,000	..	.....	158,000	4	39,500	Francis	163.6	265-114	190	MS	W	Welded pl st	Butterfly	30,000	Manual	AG	0.95	11.5	PO	35
1958	650	..	.....	650	1	650	Francis	600	.....	168	JL	....	Cast steel	Head gates	Connects to existing generator		.....	.....	.....	...	36
1958	2,000	..	.....	2,000	1	2,000	Francis	450	142-75	116	JL	W	Cast iron	Butterfly	1,500	Manual	AG	0.95	2.4	EM	37
1958	5,800	..	.....	5,800	2	2,900	Francis	514	148-145	145	JL	W	Cast iron	Butterfly	2,250	Manual	AG	0.95	2.4	EM	38
1957	7,000	..	.....	7,000	2	3,500	Francis	360	140-78	120	JL	W	Plate steel	Gate	2,750	Manual	AG	0.90	2.4	EC	39
1958	3,950	..	.....	5,925	2	1,975	Impulse	900	1,532-1,519	1,527	PB	PB	Cast steel	Slide gate	1,750	Manual	HS	0.90	2.4	EC	40
.....	1,240,000	..	.....	1,240,000	8	155,500	Francis	150	563-345	450	...	...	Cast steel	Head gates	125,000	.....	....	0.90	13.8	...	41
1959	6,300	..	.....	6,300	1	6,300	Francis	400	186-172	180	JL	PB	Welded pl st	Head gates	4,500	Automatic	....	1.00	4.16	AE	42
1959	4,250	..	.....	4,250	1	4,250	Francis	450	193-102	155	JL	W	Welded pl st	Head gates	3,158	Automatic	AG	0.80	4.16	EM	43
1955	1,607,000	12	55-57	2,707,000	10	100,000	Francis	100	179-148	165	NN	AC	Plate steel	Head gates	67,386	Manual	BG	0.95	13.8	WE	44
		4	58		6	100,000	Francis	100	179-148	165	MS	W	Plate steel	Head gates	67,386	Manual	BG	0.95	13.8	WE	
					2	3,500	Francis	514	179-148	165	PB	PB	Service unit	.....	3,000	Manual	AG	0.80	4.16	EC	
1953	1,565,200	12	53-56	2,333,000	14	111,300	Kaplan	85.7	92-62	80	MS	AC	Concrete	Head gates	73,684	Manual	BG	0.95	12	GE, ZEE	45
		2	57		2	3,500	Francis	277	92-62	80	PB	W	Service unit	.....	2,750	Manual	AG	0.80	4.16	EM	
1957	1,779,800	2	57	2,777,200	14	123,000	Kaplan	85.7	91-60	81	BL	PB	Concrete	Head gates	82,105	Manual	BG	0.95	13.8	GE	46
		4	58		2	18,800	Kaplan	200	91-60	74	AC	PB	Concrete	Head gates	14,200	Manual	BG	0.95	13.8	WE	
					2	4,500	Francis	277	91-60	81	PB	W	Service unit	.....	3,500	Manual	AG	0.80	4.16	EM	
1961	1,140,000	..	.....	1,824,000	10	114,000	Kaplan	85.7	84-32	78	EE	PB	Concrete	Head gates	83,000	Manual	BG	0.95	13.8	EE	47
1962	864,000	..	.....	1,728,000	8	108,000	Kaplan	85.7	80-52	75	...	...	Concrete	Head gates	75,000	Manual	...	0.95	13.8	....	48
1961	980,000	..	.....	1,540,000	7	140,000	Kaplan	90	98-55	92	MS	W	Concrete	Head gates	107,000	Manual	BG	0.95	15	WE	49
					3	952	Francis	171	90-60	65	MS	....	Drives pumps	.....	.....						
1961	429,000	..	.....	858,000	3	143,000	Kaplan	90	105-78	96	MS	...	Concrete	Head gates	94,737	Auto. or Man.	BG	0.95	13.8	GE	50
1958	234,400	..	.....	349,400	2	115,000	Francis	171.5	330-325	310	MS	MS	Cast steel	.....	79,000	Manual	AG	1.00	13.2	WE	51
					2	2,200	Francis	720	330-325	310	MS	MS	Cast steel	.....	1,500	Manual	AG	0.80	2.5	WE	
.....	220,000	..	.....	220,000	4	55,000	Francis	138.5	185-135	182	MS	PB	Plate steel	Head gates	45,000	Manual	BG	0.90	13.8	AC	52
1959	54,000	1	1959	131,000	1	77,000	Francis	163.6	235-200	227	MS	W	Plate steel	Butterfly	61,000	Manual	BG	0.90	13.8	GE	53
1958	120,000	..	.....	120,000	2	60,000	Francis	200	288-248	275	BL	PB	Plate steel	Head gates	47,200	Automatic	BG	0.90	13.8	GE	54
1957	10,000	1	1957	38,000	1	28,000	Francis	300	282	272	MS	W	Plate steel	Head gates	22,500	Automatic	AG	0.90	6.9	GE	55
1958	300,000	..	.....	300,000	3	100,000	Francis	180	397-275	378	MS	W	Welded pl st	Butterfly	75,555	Manual	BG	0.90	13.8	GE	56
1958	92,000	..	.....	92,000	2	46,000	Francis	128.6	128	128	MS	W	Welded pl st	Head gates	38,889	Auto. or Man.	AG	0.90	13.8	GE	57
					2	62,500	Francis	240	.....	190	MS	W	Cast steel	Butterfly	50,500	Manual	BG	0.80	13.8	WE	
1931	63,550	1	1958	194,050	1	1,050	Francis	....	.....	190	JL	W	Service unit	.....	1,250	Manual	AG	0.80	2.4	GE	58
					1	68,000	Francis	240	.....	190	AC	W	Cast steel	Butterfly	50,250	Manual	BG	0.80	13.8	GE	
1958	18,000	..	.....	18,000	1	18,000	Francis	225	162-140	158	PB	PB	Plate steel	Head gates	11,842	Manual	AG	0.95	6.6	...	59
1958	69,000	..	.....	69,000	2	34,500	Francis	138.5	135-110	130	NN	W	Riveted pl st	Head gates	24,000	Automatic	BG	0.80	13.8	WE	60
1958	165,000	..	.....	165,000	3	55,000	Francis	138.5	158-150	150	MS	W	Riveted pl st	Head gates	36,000	Manual	BG	0.90	13.8	GE	61
1958	25,500	1	1958	60,000	1	34,500	Francis	138.5	132-116	130	NN	W	Riveted pl st	Head gates	26,000	Manual	BG	0.80	13.8	WE	62
1958	112,000	..	.....	112,000	2	56,000	Francis	277	463	440	BL	PB	Welded pl st	Butterfly	42,100	Automatic	AG	0.95	11.5	GE	63

EEC - English Electric Co of Canada Ltd
EM - Electric Machinery Mfg Co
GE - General Electric Co
GGG - Gilbert Gilkes & Gordon Ltd
IE - Ideal Electric & Mfg Co
JL - James Leffel & Co

KMW - KMW of Sweden
MS - S Morgan Smith Co
MSI - S Morgan Smith-Inglis Co
MVE - Metropolitan Vickers Electric Co Ltd
NBP - Neyret-Beylier & Piccard Pictet
NN - Newport News Shipbuilding & Dry Dock Co

PO - Pacific Oerlikon Co
PB - Pelton Div, Baldwin-Lima-Hamilton Corp
SEC - Swedish Electric Co
SGE - Swedish General Electric Co
VIW - Vancouver Iron Works Ltd
W - Woodward Governor Co

WE - Westinghouse Electric Corp
[5]AG, indicates thrust bearing is above generator rotor; BG, thrust bearing is below generator rotor, HS, horizontal-shaft machine.
[6]Vertical-shaft, 4-jet type
[7]Vertical-shaft, 6-jet type

Typical hydroelectric plants continued

Project No.	Company or government agency	Designing or consulting engineers	Project name	[1]New or redeveloped	River	State	Projected started year	[2]Dam, type	Crest Length, ft	Max. height, ft	[3]Type of installation
	PACIFIC COAST STATES, Cont										
64	California Oregon Power Co	Pioneer Service & Engineering Co	Eagle Point	New	Canal	Ore.	1956	CG	120	15	I
65	U. S. Army Engineers	U. S. Army Engineers	Hills Creek	New	M F Willamette	Ore	1956	.....	.....	.....	I
66	U. S. Army Engineers	U. S. Army Engineers	Cougar	New	McKenzie	Ore.	1956	RF	.....	.....	I
67	U. S. Bureau of Reclamation	U. S. Bureau of Reclamation	Green Springs	New	Emigrant Creek	Ore.	1956	.....	.....	.....	O
68	Idaho Power Co	International Engr Co, J P Growdon	Brownlee	New	Snake	Ore. & Idaho	1955	E & RF	1,330	395	O
69	Idaho Power Co	I C Steel & Harold Stearns	Oxbow	New	Snake	Idaho	1955	E & RF	1,100	200	O
70	Pacific Gas & Electric Co	Pacific Gas & Electric Co	Poe	New	Feather	Calif.	1954	CG	430	60	S
71	Pacific Gas & Electric Co	Pacific Gas & Electric Co	Butt Valley	New	Butt Creek	Calif.	1956	HF	1,250	130	I
72	Pacific Gas & Electric Co	Pacific Gas & Electric Co	Caribou No. 2	New	Feather	Calif.	1956	Earth	1,370	80	I
73	Pacific Gas & Electric Co	Pacific Gas & Electric Co	Belden	New	Feather	Calif.	1957	CG	505	150	I
74	Pacific Gas & Electric Co	Pacific Gas & Electric Co	Kings River	New	Kings	Calif.	1959	Arch	190	183	O
75	Pacific Gas & Electric Co	Pacific Gas & Electric Co	Balch	Red	Kings	Calif.	1956	Arch	388	148	O
76	Pacific Gas & Electric Co	Pacific Gas & Electric Co	Haas	New	Kings	Calif.	1955	RF	950 3,350	360 270	U
77	Southern California Edison Co	I Campbell; J Hinds; K Terzaghi; S D Wilson; C R Rankin; Bechtel Corp & So Calif. Edison Engrg Dept	Mammoth Pool	New	San Joaquin	Calif.	1958	EF	820	330	O
78	Sacramento Municipal Utility Dist	Bechtel Corp & F F Bonnet	Jaybird	New	American	Calif.	1958	.....	.....	.....	I
79	City & County of San Francisco	Consultant Bd & Sverdrup & Parcel	Cherry	New	Cherry	Calif.	1955	E & RF	2,600	330	I
80	Oakdale & San Joaquin Irr Dist	Tudor Goodenough Engineers,	Tri-Dam Tulloch	New	Stanislaus	Calif.	1955	CG	1,600	200	I
81	Oakdale & San Joaquin Irr Dist	International Engineering Co &	Tri-Dam Donnells	New	Stanislaus	Calif.	1955	CA	800	477	I
82	Oakdale & San Joaquin Irr Dist	George E Goodall Co	Tri-Dam Beardsley	New	Stanislaus	Calif.	1955	EF	1,000	320	I
	U. S. POSSESSIONS										
83	Ketchikan Public Utilities	R W Peck & Associates	Ketchikan Lake	Red	.....	Alaska	1957	RF	1,197	35	I
	CANADA					PROVINCE					
84	Newfoundland Light & Power Co Ltd	Montreal Engineering Co	Rattling Brook	New	Rattling Brook	N.F.	1957	Earth	3,500	40	I
85	United Towns Electric Co Ltd	Power Corp of Canada Ltd	New Chelsea	New	Chelsea	N.F.	1955	Earth	.....	.....	I
86	Union Electric Light & Power Co Ltd	G H Desbarats	Lockston	New	Trinity	N.F.	1954	CG	200	10	I
87	United Towns Electric Co Ltd	.....	Lookout Brook	New	.....	N.F.	.....	.....	.....	.....	I
88	Bowater Power Co Ltd	Shawinigan Engineering Co	Corner Brook	New	Corner Brook	N.F.	1956	CG	98	25	I
89	Nova Scotia Light & Power Co Ltd	Company Engineers	Avon No. 1	Red	Avon	N.S.	1957	EF	600	45	I
90	Nova Scotia Power Commission	N. S. Power Comm & K E Whitman	Ridge	New	Bear	N.S.	1956	EF-CW	2,966	42	I
91	New Brunswick Electric Power Comm	Shawinigan Engineering Co	Beachwood	New	St John	N.B.	1955	CG	680	100	I
92	Quebec Hydro-Electric Commission	H G Acres & Co	Bersimis No. 1	New	Bersimis	Que.	1953	RF	1,042 2,215	230 200	U
93	Quebec Hydro-Electric Commission	H G Acres & Co	Bersimis No. 2	New	Bersimis	Que.	1956	CG EF EF	2,000 3,600 3,300	290 40 70	I
94	Quebec Hydro-Electric Commission	.....	Beauharnois No. 1	New	St Lawrence	Que.	1929	.....	.....	.....	I
95	Quebec Hydro-Electric Commission	H G Acres & Co	Beauharnois No. 2	New	St Lawrence	Que.	1948	P & G	4,500	31	I
96	Quebec Hydro-Electric Commission	H G Acres & Co	Beauharnois No. 3	New	St Lawrence	Que.	1956	.....	.....	.....	I
97	Shawinigan Water & Power Co	Shawinigan Engineering Co	Beaumont	New	St Maurice	Que.	1956	CG	1,575	185	S
98	Aluminum Company of Canada	H G Acres & Co	Chute des Passes	New	Peribonka	Que.	1956	CG	1,156	170	U
99	Manicouagan Power Co	H G Acres & Co	McCormick Dam	New	Manicouagan	Que.	1951	CG	4,575	95	I
100	Price Brothers & Co	Montreal Engineering Co	Chute Wilson	New	Shipshaw	Que.	1956	.....	.....	.....	I
101	Eastern Smelting & Refining Corp	Montreal Engineering Co	Smelter Power	New	Chicoutimi	Que.	1955	CG	460	50	I
102	James Maclaren Co	Shawinigan Engineering Co	Dufferin Falls	New	Lievre	Que.	1957	CG	700	64	I
103	E B Eddy Co	.....	Hull	Red	Ottawa	Que.	1956	.....	.....	.....	I
104	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Sir Adam Beck Niagara No. 2	New	Niagara	Ont.	1948	.....	.....	.....	I
105	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Sir Adam Beck Niagara No. 2	New	Niagara	Ont.	1952	RF	24,937	68	O
106	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Robert H Saunders	New	St Lawrence	Ont.	1954	CG CG	3,120 2,250	145 100	S
107	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Manitou Falls	New	English	Ont.	1953	CG	1,069	40	I
108	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Whitedog Falls	New	Winnipeg	Ont.	1955	CG	1,130	80	I
109	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Caribou Falls	New	English	Ont.	1956	CG & EF	1,800	75	I
110	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Silver Falls	New	Kaministikwia	Ont.	1957	.....	.....	.....	I
111	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Alexander Falls	New	Nipigon	Ont.	1926	EF	750	90	I
112	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Cameron Falls	New	Nipigon	Ont.	1918	.....	.....	.....	I
113	Hydro-Electric Power Comm of Ontario	Hydro-Electric Power Comm of Ontario	Abitibi Canyon	New	Abitibi	Ont.	1930	.....	.....	.....	I
114	Great Lakes Power Co	Harza Engineering Co	Cat Falls	New	Michipicoten Shikwankwa	Ont.	1957	CG & EF EF	1,500 1,400	140 135	I
115	Great Lakes Power Co	Harza Engineering Co	Gartshore Falls	New	Montreal	Ont.	1956	CG	1,100	130	I
116	Great Lakes Power Co	Harza Engineering Co	Upper Falls	New	Montreal	Ont.	1955	CG	1,300	90	I
117	Manitoba Hydro-Electric Board	H G Acres & Co	Kelsey	New	Nelson	Man.	1957	RF	850	.....	I
118	Sherritt-Gordon Mines Ltd	H G Acres & Co	Laurie River No. 2	New	Laurie	Man.	1956	CG	1,000	65	I
119	Churchill River Power Co	.....	Island Falls	New	.....	Sask.	1936	.....	.....	.....	I
120	Calgary Power Co	Montreal Engineering Co	Cascade Extension	New	Cascade	Alta.	1956	.....	.....	.....	I
121	Calgary Power Co	Montreal Engineering Co	Rundle	New	Bow	Alta.	1950	Earth	.....	.....	I
122	Calgary Power Co	Montreal Engineering Co	Spray	New	Spray	Alta.	1948	R & EF	625	190	I
123	Aluminum Company of Canada	B C International Engrg Co	Kemano	New	Nechako	B.C.	1951	RF	1,550	319	U
124	British Columbia Electric Co	B C International Engrg Co	Seton	New	Seton & Cayoosh Creek	B.C.	1954	TC CG	800 450	20 25	I
125	British Columbia Electric Co	B C Engineering Co Dr K Terzaghi & Dr V Dolmage	Cheakmus	New	Cheakmus	B.C.	1954	EF	2,000	90	I
126	British Columbia Electric Co	B C Engineering Co Dr K Terzaghi & Dr A Casagrande	Bridge No. 2	New	Bridge	B.C.	1956	EF	1,300	175	I
127	British Columbia Electric Co	B C Engineering Co	Clowhom	Red	Clowhom	B.C.	1956	CG	1,250	73	I
128	British Columbia Electric Co	B C Engineering Co	La Joie	New	Bridge	B.C.	1956	RF	3,390	272	I
129	British Columbia Power Comm	H G Acres & Co	Ladore	New	Campbell	B.C.	1955	CG	.....	.....	S
130	British Columbia Power Comm	H G Acres & Co	Upper Campbell Lake	New	Campbell	B.C.	1955	EF	1,700	170	S
131	British Columbia Power Comm	Crippen Wright Engrg; H G Acres & Co	Ash River	New	Ash	B.C.	1957	EF	605	100	I
132	Pacific Petroleum Ltd	.....	Dawson Creek	New	.....	B.C.	1956	.....	.....	.....	I
133	Northern Canada Power Comm	Montreal Engineering Co	Mayo River	New	Mayo	Yukon	1951	Earth	400	100	I
134	Northern Canada Power Comm	Montreal Engineering Co	Yukon	New	Whitehorse Rapids	Yukon	1956	EF	280	63	I

[1]The term "New" applies to a project on a site not developed before. "Redeveloped" indicates a project on a site that has been developed before and now has new turbines, settings, generators or a new plant.

[2]A&G, arch and gravity; CA, concrete arch; CG& EF, concrete gravity and earth fill; CG, S&B, concrete gravity, slab & buttress; CS&B, concrete slab and buttress; EF, earth fill; EF&RF, earth/laced, rock fill; EF-CW, earth fill with concrete core wall; HF, hydraulic fill; P&G,piers &gates; RF, rock fill; RFCF, rock fill, concrete face; REF, relied earth fill; SG sector gates; S&R, sluiceways and rock fill; TC timber crib.

[3]I, indoor; S, semi-outdoor; O, outdoor; U, underground.

[4]AC - Allis-Chalmers Mfg Co
AE - American Elin Corp
ASG - Ansaldo-San Giorgio
BB - Brown Boveri Corp
BL - Baldwin Lima-Hamilton Corp
CAC - Canadian Allis-Chalmers Ltd
CBS - Charles Barber & Sons
CGE - Canadian General Electric
CVL - Canadian Vickers Ltd
CWC - Canadian Westinghouse Co Ltd
DEC - Dominion Engineering Co Ltd
EC - Elliott Co
EE - English Electric Co Ltd

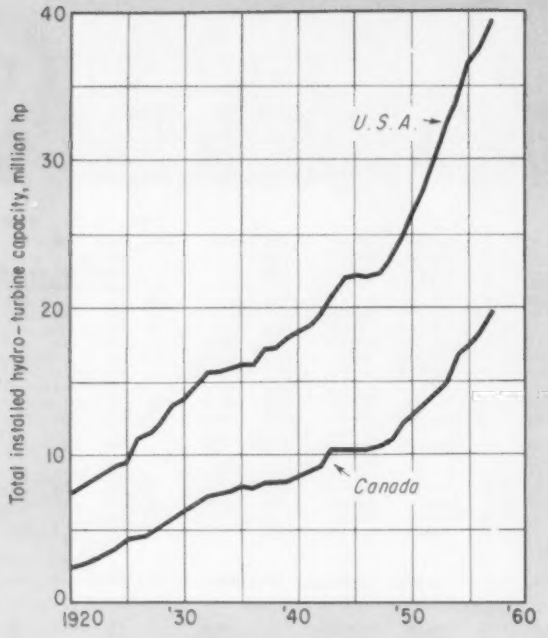
Initial operation, year	Initial capacity, hp	Added capacity, No. of units	Added capacity, year	Ultimate capacity, hp	No. of units installed	Hydro-turbine capacity, hp	Hydro-turbine, type	Speed, rpm	Static head, ft	Design head, ft	[4]Hydro-turbine manufacturer	[4]Governor manufactured	Scroll case, concrete or steel	Penstock valve, type	Generator capacity, kva	Synchronizing, manual or automatic	[5]Thrust-bearing location	Design power factor	Kilovolts	[4]Generator manufacturer	Project No.
1957	3,900	..	.....	3,900	1	3,900	Francis	720	434	409	JL	W	Cast steel	Gate valve	3,125	Manual	HS	0.90	2.4	WE	64
1961	43,400	..	.....	43,400	2	21,700	Francis	257	319-189	256	....	....	Cast steel	Butterfly	16,667	.....	....	0.90	13.8	....	65
1960	34,520	..	.....	69,040	1	34,520	Francis	257	442-257	321	....	....	Cast steel	Butterfly	26,316	.....	....	0.95	13.8	....	66
1959	23,500	..	.....	23,500	1	23,500	Impulse 6	600	1,986-1,960	1,800	AC	W	Cast steel	Rotary	16,842	Automatic	AG	0.95	4.16	PO	67
1958	556,000	..	.....	834,000	4	139,000	Francis	128.6	277-176	274	MS	W	Plate steel	Head gates	100,111	Manual	BG	0.90	13.8	WE	68
1959	292,000	..	.....	438,000	4	73,000	Francis	94.8	117-111	115	NN	W	Plate steel	Head gates	52,778	Manual	BG	0.90	13.8	WE	69
1958	152,000	..	.....	152,000	2	76,000	Francis	225	492-467	421	PB	PB	Cast & pl st	Butterfly	69,000	Automatic	AG	0.90	13.8	GE	70
1958	50,000	..	.....	50,000	1	50,000	Francis	200	380-295	313	MS	....	Plate steel	Butterfly	40,000	Automatic	AG	0.90	13.8	GE	71
1958	152,000	..	.....	152,000	2	76,000	Impulse 7	240	1,152-1,136	1,110	AC	AC	Cast steel	Rotary	61,000	Automatic	AG	0.90	13.8	GE	72
1961	156,000	..	.....	156,000	2	78,000	Francis	300	770	658	....	....	Cast & pl st	Butterfly	63,500	Automatic	AG	0.90	13.8	WE	73
1961	60,000	..	.....	60,000	1	60,000	Francis	.....	793-709	.....	....	....	Cast & pl st	Butterfly	49,000	Automatic	AG	0.90	13.8	....	74
1958	46,000	2	1958	180,000	2	67,000	Impulse 6	400	2,389-2,350	2,293	PB	PB	Cast steel	Spherical	54,000	Automatic	AG	0.90	13.8	AC	75
1960	184,000	..	.....	184,000	2	92,000	Impulse 7	400	2,444-2,234	2,324	PB	PB	Cast steel	Spherical	75,000	Automatic	AG	0.90	13.8	WE	76
1960	176,000	..	.....	176,000	2	88,000	Francis	360	1,100-900	950	MS	....	Welded pl st	Butterfly	63,000	Automatic	....	1.00	13.8	WE	77
1960	88,000	..	.....	176,000	1	88,000	Impulse 7	300	1,527-1,459	1,432	AC	AC	Cast steel	Rotary	70,000	Auto. or Man.	AG	0.95	13.8	GE	78
1960	187,000	..	.....	187,000	2	93,500	Impulse 7	400	2,484-2,324	2,290	PB	PB	Cast steel	Butterfly	75,000	Automatic	AG	0.90	13.8	AC	79
1958	24,000	..	.....	24,000	2	12,000	Francis	240	157-54	153	MS	W	Plate steel	Head gates	9,500	Manual	AG	0.90	6.9	EC	80
1957	74,500	..	.....	74,500	1	74,500	Impulse 7	240	1,481-1,286	1,151	AC	AC	Cast steel	Rotary	67,500	Auto. or Man.	AG	0.80	13.8	AC	81
1957	14,000	..	.....	14,000	1	14,000	Francis	300	264-128	258	AC	AC	Riveted pl st	Butterfly	11,000	Manual	AG	0.90	6.9	AC	82
1958	6,500	1	1958	9,000	1	2,500	Francis	720	250-200	250	JL	W	Plate steel	Butterfly	1,750	Manual	BG	0.80	4.16	IE	83
1958	17,000	..	.....	17,000	2	8,500	Francis	514.3	330-320	307	CAC	W	Plate steel	Butterfly	7,500	Automatic	AG	0.85	6.9	CGE	84
1957	5,600	..	.....	5,600	1	5,600	Francis	514.3	.....	275	DEC	W	Plate steel	Butterfly	5,000	Auto. or Man.	AG	0.80	6.9	CWC	85
1956	2,000	1	1958	4,000	2	2,000	Francis	720	280-277	270	GGG	GGG	Cast steel	Gate	1,875	Manual	HS	0.80	6.9	CGE	86
.....	3,700	1	1958	7,300	1	3,600	Francis	900	.....	.....	....	....	.....	.....	3,000	Manual	HS	0.8	....	CGE	87
1958	12,000	..	.....	12,000	2	6,000	Francis	1,000	572	526	EEC	W	Welded pl st	Sluice valves	5,100	Automatic	HS	0.90	4.2	EE	88
1958	5,000	..	.....	5,000	1	5,000	Francis	360	130-120	118	CVL	W	Cast steel	Head gates	4,500	Automatic	AG	....	2.3	BB	89
1957	5,300	..	.....	5,300	1	5,300	Francis	360	149-147	140	MSC	W	Plate steel	Butterfly	5,000	Automatic	AG	0.80	6.6	CGE	90
1958	90,000	..	.....	135,000	2	45,000	Kaplan	109.1	61-20	57	DEC	SGE	Concrete	Head gates	40,000	Manual	BG	0.90	13.8	CGE	91
1957	1,200,000	..	.....	1,200,000	4	150,000	Francis	277	880-850	785	EEC	W	Plate steel	Spherical	120,000	Automatic	AG	0.95	13.8	MVE	92
					4	150,000	Francis	277	880-850	785	NBP	NBP	Plate steel	Spherical	120,000	Automatic	AG	0.95	13.8	CGE	
1959	855,000	..	.....	855,000	5	171,000	Francis	163.6	390-350	380	DEC	W	Plate steel	Rotary	120,000	Manual	BG	0.95	13.8	CGE	93
1932	758,000	..	.....	758,000	14	53,000	Francis	75	82-75	80	DEC	DEC	Concrete	Head gates	46,625	Manual	BG	0.90	13.8	CGE	94
					2	8,000	Francis	180	82-75	80	DEC	DEC	Concrete	Head gates	7,200	Manual	AG	0.90	13.8	CGE	
1950	636,000	..	.....	636,000	6	53,000	Francis	75	82-75	80	CAC	W	Concrete	Head gates	51,000	Automatic	BG	0.80	13.8	CWC	95
					6	53,000	Francis	75	82-75	80	DEC	W	Concrete	Head gates	51,000	Automatic	AG	0.80	13.8	CGE	
1959	810,700	..	.....	810,700	11	73,700	Propeller	94.7	83-76	78	EEC	W	Concrete	Head gates	65,000	Automatic	BG	0.85	13.8	6CWC	96
1958	330,000	..	.....	330,000	6	55,000	Francis	120	133-102	124	CAC	W	Welded pl st	Head gates	45,000	Auto. or Man.	AG	0.90	13.8	CGE	97
1959	1,000,000	..	.....	1,000,000	5	200,000	Francis	200	649-549	540	EEC	....	Welded pl st	Spherical	165,000	Auto. or Man.	BG	0.90	13.8	CGE	98
1952	112,400	3	57-58	337,200	2	56,200	Francis	112.5	128-116	124	MSC	W	Welded pl st	Head gates	37,500	Automatic	AG	0.95	13.8	CGE	99
					3	65,000	Francis	112.5	128-116	124	CAC	CAC	Welded pl st	Head gates	50,000	Automatic	AG	0.80	13.8	CGE	
1957	80,000	..	.....	80,000	1	80,000	Francis	180	275-270	259	KMK	W	Plate steel	Butterfly	70,000	Automatic	BG	0.90	13.8	CWC	100
1957	42,000	..	.....	42,000	1	42,000	Francis	257	285-277	278	MSC	W	Welded pl st	Head gates	40,000	Automatic	AG	0.80	13.8	CGE	101
1959	50,000	..	.....	50,000	2	25,000	Kaplan	163.6	59-69	62	EEC	W	Concrete	Head gates	22,500	Automatic	BG	0.85	13.2	CWC	102
1957	2,900	..	.....	2,900	2	1,450	Francis	163.6	38	38	JL	....	Plate steel	Head gates	Connects to existing generators				.....	.....	103
1954	1,680,000	4	57-58	1,680,000	16	105,000	Francis	150	305-294	292	DEC	W	Plate steel	Head gates	80,000	Automatic	AG	0.95	13.8	CGE	104
															80,000	Automatic	BG	0.95	13.8	CWC	
1957	270,000	3	1958	270,000	6	45,000	Deriaz	92.3	87-40	83	EEC	W	Plate steel	Head gates	31,000	Manual	BG	0.95	13.8	CWC	105
					[1]These units operate in reverse as 55,000-hp, 4,600-cfs, 75-ft head pumps. Head ranges from 59 to 80 ft.																
1958	1,200,000	..	.....	1,200,000	8	75,000	Propeller	94.7	.....	81	EEC	W	Concrete	Head gates	60,000	Automatic	BG	0.95	13.8	CWC	106
					8	75,000	Propeller	94.7	.....	81	EEC	W	Concrete	Head gates	60,000	Automatic	BG	0.95	13.8	CGE	
1956	74,000	1	1958	92,500	5	18,500	Propeller	150	59-44	54	DEC	W	Concrete	Head gates	16,000	Automatic	BG	0.90	13.8	CGE	107
1958	81,000	..	.....	81,000	3	27,000	Propeller	105.9	54-40	50	DEC	W	Concrete	Head gates	24,000	Automatic	BG	0.90	13.8	CWC	108
1958	102,000	..	.....	102,000	3	34,000	Propeller	112.5	62-53	58	DEC	W	Concrete	Head gates	28,500	Automatic	BG	0.90	13.8	CGE	109
1959	60,000	..	.....	60,000	1	60,000	Francis	257	362-346	350	CAC	W	Welded pl st	Butterfly	48,500	Automatic	BG	0.90	13.8	CWC	110
1930	73,000	1	1958	92,000	3	18,000	Francis	100	60-56	50	MSI	W	Concrete	Head gates	15,000	Manual	AG	0.85	12.0	CGE	111
					2	19,000	Propeller	150	60-56	58	DEC	W	Concrete	Head gates	15,000	Automatic	AG	0.90	12.0	CGE	
1920	75,000	1	1958	100,000	10	12,500	Francis	120	76-70	72	BL, AC, CVL	W	Concrete	Head gates	10,600	Manual	AG	0.85	....	CWC, CGE	112
					1	25,000	Propeller	165.5	76-70	73	DEC	W	Concrete	Head gates	20,000	Automatic	BG	0.95	12.0	CWC	
1932	264,000	1	1959	330,000	4	66,000	Francis	150	239-227	237	CAC	CAC	Plate st	Head gates	48,000	Manual	BG	0.90	13.8	CGE	113
1959	30,300	..	.....	30,300	1	30,300	Kaplan	200	116-55	108	DEC	W	Welded pl st	Head gates	22,222	Automatic	BG	0.90	11.5	CGE	114
1958	30,300	..	.....	30,300	1	30,300	Kaplan	240	118-100	112	DEC	W	Plate steel	Head gates	22,222	Automatic	BG	0.90	11.5	CWC	115
1956	26,800	1	1957	58,300	1	31,500	Francis	240	247-190	236	MS	W	Plate steel	Head gates	25,000	Manual	BG	0.90	13.8	CWC	116
1960	168,000	..	.....	168,000	4	42,000	Propeller	90	47-58	55	DEC	....	Concrete	Head gates	.....	.....	....	....	....	CGE	117
1957	7,000	..	.....	7,000	1	7,000	Francis	300	65-51	55	EEC	W	Concrete	Head gates	6,000	Automatic	BG	0.90	2.4	CGE	118
1938	57,000	1	1959	133,000	7	19,000	Propeller	150	56	56	DEC	W	Concrete	Head gates	18,000	Manual	AC	0.90	6.6	CGE	119
1957	23,000	1	1957	46,000	2	23,000	Francis	300	340-320	320	DEC	SGE	Plate steel	Pivot	20,000	Automatic	AG	0.85	13.8	CWC	120
1931	23,000	1	1959	63,000	1	23,000	Francis	300	318	318	DEC	W	Welded pl st	Head gates	20,000	Auto. or Man.	AG	0.85	13.8	CWC	121
					1	40,000	Francis	300	318	318	DEC	W	Welded pl st	Head gates	35,000	Auto. or Man.	AG	0.85	13.8	CWC	
1951	62,000	1	1959	124,000	2	62,000	Francis	450	910	900	DEC	W	Welded pl st	Spherical	55,000	Automatic	AG	0.85	13.2	CWC	122
1954	450,000	1	1958	2,400,000	3	150,000	Impulse 6	327	2,570	2,500	DEG	W	Cast steel	Spherical	114,000	Manual	AG	0.80	....	CGE, EEC	123
					3	150,000	Impulse 6	327	2,570	2,500	CAG	W	Cast steel	Spherical	114,000	Manual	AG	0.80	13.8	CGE	
					3	150,000	Impulse 6	327	2,570	2,500	PB; VIW	PB	Cast steel	Spherical	114,000	Manual	AG	0.80	....	EEC, CWC	
					1	150,000	Impulse 6	327	2,570	2,500	DEC	W	Cast steel	Spherical	114,000	Manual	AG	0.80	13.8	CWC	
1957	58,500	..	.....	58,500	1	58,500	Francis	120	167-129	147	CAC	W	Plate steel	Head gates	40,000	Automatic	BG	1.00	13.8	CWC	124
1957	190,000	..	.....	190,000	2	95,000	Francis	300	1,155-1,125	1,070	PB; VIW	PB	Cast steel	Butterfly	80,000	Automatic	AG	0.90	13.8	CWC	125
1959	328,000	..	.....	328,000	4	82,000	Impulse 7	300	1,351-1,215	1,218	PB; VIW NBP	PB; NBP	Cast steel	Spherical	65,000	Automatic	AG	0.95	13.8	CWC	126
1957	40,000	..	.....	40,000	1	40,000	Francis	171	193-130	145	PB; VIW	PB	Plate steel	Butterfly	31,500	Automatic	AG	0.95	13.8	CWC	127
1957	30,000	..	.....	30,000	1	30,000	Francis	200	260-132	176	CAC	W	Plate steel	Butterfly	24,500	Automatic	BG	0.90	13.8	CGE	128
1957	70,000	..	.....	105,000	2	35,000	Francis	138.5	126-75	122	DEC	W	Plate steel	Butterfly	30,000	Automatic	BG	0.90	13.8	CGE	129
1958	42,000	..	.....	126,000	1	42,000	Francis	138.5	150-80	140	CAC	W	Plate steel	Butterfly	37,500	Automatic	BG	0.90	13.8	CWC	130
1959	35,000	..	.....	35,000	1	35,000	Francis	514	824-746	742	ASG	W	Welded pl st	Butterfly	28,000	Automatic	AG	0.90	13.8	CWC	131
1957	750	..	.....	750	1	750	Francis	786	150	150	JL	....	Plate steel	Head gates	Drives pumps				.....	.....	132
1952	3,000	1	1958	6,000	2	3,000	Francis	450	120-110	118	DEC; GGG	W	Plate steel	Butterfly	3,000	Manual	AG	0.85	6.9	CGE	133
1958	15,000	..	.....	22,500	2	7,500	Francis	257	63	61	KMW	W	Plate steel	Head gates	6,700	Automatic	BG	0.85	6.9	CWC	134

GE - General Electric Co
GGG - Gilbert Gilkes & Gordon Ltd
IE - Ideal Electric & Mfg Co
JL - James Leffel & Co
EEC - English Electric Co of Canada Ltd
EM - Electric Machinery Mfg Co

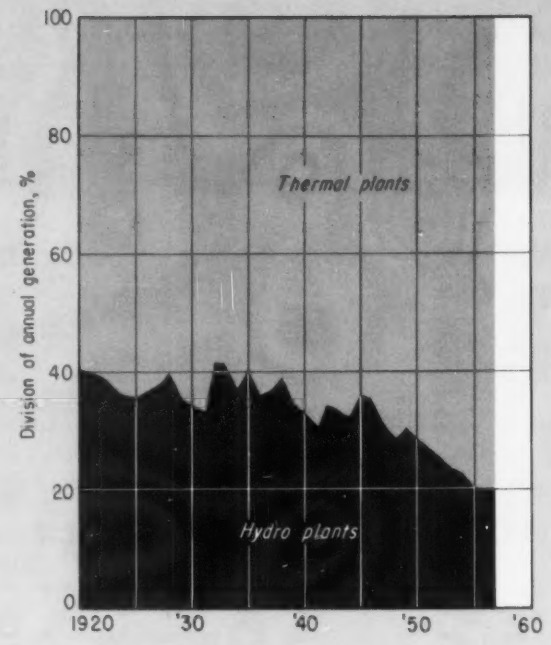
KMW - KMW of Sweden
MS - S Morgan Smith Co
MSI - S Morgan Smith-Inglis Co
MVE - Metropolitan Vickers Electric Co Ltd
NBP - Nayret-Beylier & Piccard Pictet
NN - Newport News Shipbuilding & Dry Dock Co

PO - Pacific Oerlikon Co
PB - Pelton Div, Baldwin-Lima-Hamilton Corp
SEC - Swedish Electric Co
SGE - Swedish General Electric Co
VIW - Vancouver Iron Works Ltd
W - Woodward Governor Co

WE - Westinghouse Electric Corp
[5]AG, indicates thrust bearing is above generator rotor; BG, thrust bearing is below generator rotor. HS, horizontal-shaft machine.
[6]Vertical-shaft, 4-jet type
[7]Vertical-shaft, 6-jet type



HYDRO CAPACITY continues long-term upward trend in both U.S. and Canada; hp includes central station and industrial



HYDRO GENERATION in U.S. utility systems, though growing steadily, supplies shrinking share of the total kwhr output

Hydro booms in U.S. and Canada

Backlog of turbine orders, 14,000,000 hp, and the number of large projects under way for which equipment has not been ordered indicate a healthy growth for several years. Largest hydro sites will all be developed in about ten years in the U.S. After that rate of capacity increase will decline.

Niagara. Congressional authorization for the Power Authority of New York State to build the $600-million Niagara Falls project was the outstanding hydro event of 1957. This development will use 315 ft of the 327-ft fall from Lake Erie to Lake Ontario. It will develop a total of 2,600,000 hp in thirteen 200,000-hp units in a powerhouse at Lewiston.

A 336,000-hp pumped-storage plant with twelve 28,000-hp pump-turbines forms part of this project, making it the largest of its type in the world. This Niagara Falls project will also have the largest pumping capacity in the world, 40,800 cfs against an 85-ft head.

Pumped storage. Continuing interest in pumped-storage hydro plants was shown by studies of three projects in addition to the Niagara project. These are in Virginia, New Jersey and Missouri. While none have reached final design stage, the Virginia development promises an early start because the Federal Power Commission has approved it.

Passamaquody. International Joint Commission of Canada and U.S. will study again the feasibility of the Passamaquody Bay tidal power project. The plant would have thirty 14,000-hp 40-rpm fixed-blade propeller turbines with a head range of 12 to 26 ft. The study will take about two years to finish.

Canada. Over 1,540,000 hp went into operation during 1957 and about 2,200,000 hp is expected to go on the line this year. This high rate of capacity increase cannot continue indefinitely because all sites within economic transmission distances are being developed rapidly.

Hydro-Electric Power Commission of Ontario will complete during this year its 2,500,000-hp Niagara Falls development in three plants. One plant has six 45,000-hp pump-turbines for pumped-storage operation. In the International section of the St. Lawrence River the Robert H Saunders plant, 1,200,000 hp, began running in July and will be completed in 1960, the last major hydro site in Ontario.

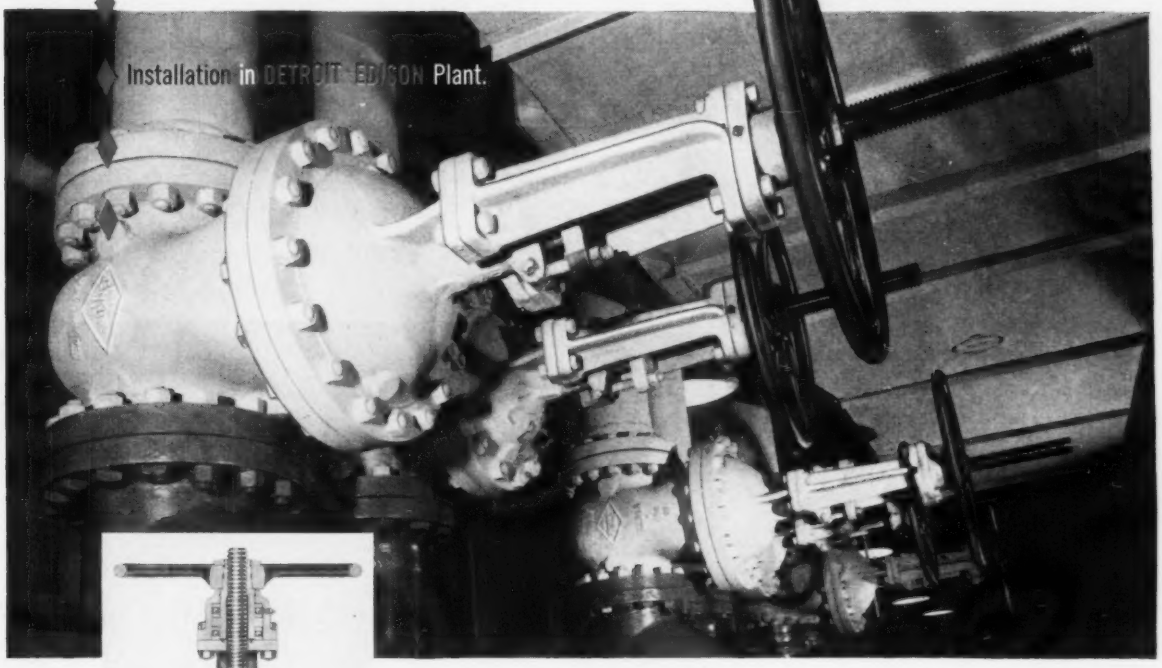
The Quebec Hydro-Electric Commission will complete Bersimis No. 1 this year, an underground plant with 1,200,000 hp in eight 150,000-hp units. The Commission is also building Bersimis No. 2 with five 171,000-hp turbines and the Beauharnois No. 3 plant which has eleven 73,700-hp turbines scheduled for 1959 operation.

The Aluminum Company of Canada is building a 1,000,000-hp underground plant with five 200,000-hp turbines for 1959 initial operation in Quebec.

Power generation in Canada rose to 90.3 billion kwhr in 1957. Water power plants generated 93% of this total. Of the national total, 90% was generated by central stations, private and provincial. 10% by industrial power plants.

where they really know Costs

—you'll likely see the famous Jenkins mark on CAST STEEL Valves



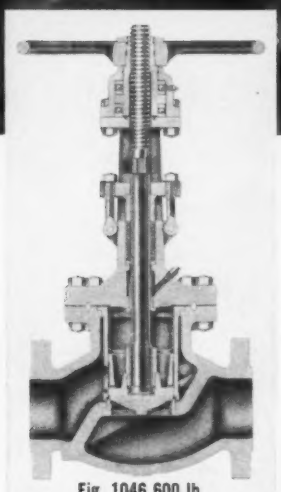


Fig. 1046 600 lb. O.S. & Y. Globe

In the power generation and industrial processing plants where Cast Steel valves are numbered by the score . . . where replacement and maintenance costs are recorded to the last penny . . . the true economy of Jenkins Valves is clearly seen.

Records will always show the extra value which Jenkins builds into Cast Steel valves, not only with design features you can see but also with unbending quality standards for alloys, castings, machining. Plus the toughest known testing and inspection system to assure perfection in every detail, and safety factors far beyond ratings.

Select from the Big Line in this Catalog. It includes pressure castings of Carbon, Carbon-Moly, 1¼% Chromium-Moly, 4% — 6% Chromium-Moly, 3½% Nickel . . . alloys that meet a wide variety of specifications. Also, a wide choice of patterns, sizes and seating material combinations to satisfy your different service conditions.

CALL YOUR JENKINS DISTRIBUTOR for a copy of Jenkins Cast Steel Valve Catalog and prices. Or write to Jenkins Bros., 100 Park Ave., New York 17.

Typical Jenkins features deliver lasting economy

A ball bearing yoke sleeve is standard on larger sizes • Cooling chamber and plugged connection for test purposes is regularly provided below packing box, but a lantern gland stuffing box is optional • Rustproof, lubricated and graphited, wire reinforced packing is standard • Soft steel ring joint body-bonnet gasket, fitted into accurately matched grooves to assure a vapor-tight joint • Seating is regrind-renew type.

JENKINS

LOOK FOR THE JENKINS DIAMOND

VALVES

JENKINS SINCE 1864 Jenkins Bros.

Jenkins cast steel Valves

Sold Through Leading Distributors Everywhere

For more facts circle 844 on Reader Service Card p 222

"BUFFALO" MATCHES FAN TO REQUIREMENTS

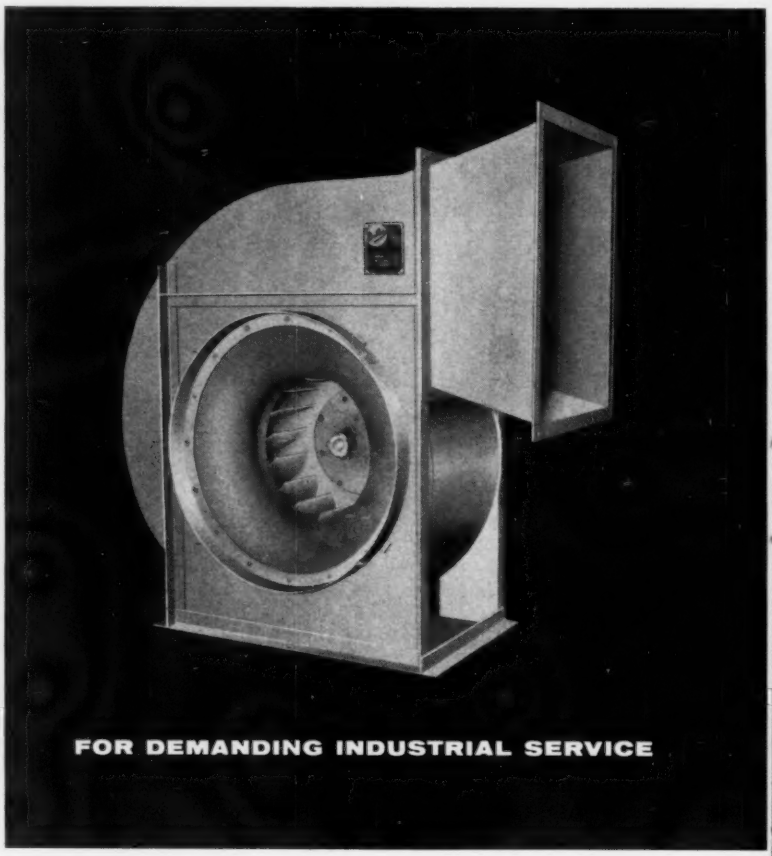
● "Buffalo" believes in designing specific *separate* fans to meet different performance requirements — not merely offering variations of the same basic fan design to meet varying needs.

Shown here are three of the many fans in the complete "Buffalo" line engineered to cover every type of heavy-duty industrial and power plant application.

These three "Buffalo" Fans — the "CR", the "BL" and the "BLH" — are designed to fulfill your central system or mechanical draft requirements with the highest possible efficiency, dependability and overall economy. Behind these fans are the 81 years of "Buffalo" research and engineering experience, plus up-to-the-minute design improvements, to insure a long life of useful service.

Whatever your requirements for heavy-duty air moving, whether for mechanical draft or ventilating purposes, there's one *right* "Buffalo" fan to do your job best. For expert engineering assistance, contact your nearest "Buffalo" Representative — or write for the Bulletins covering your needs.

The "Buffalo" Type "CR" Radial Blade Fan was specially designed for heavy-duty industrial and power plant service. It has gained wide acceptance for induced draft applications, particularly with stoker-fired or pulverized coal boilers. It is extensively used throughout the steel, cement, mining and many other industries. The rugged construction and wear-resistant qualities of the "CR" assure a long life of maintenance-free service. Its high capacity, high pressure performance may enable you to utilize a smaller, less expensive fan for many direct-connected requirements. For full information on the "Buffalo" Type "CR" Fan, write for Bulletin FD-205.



FOR DEMANDING INDUSTRIAL SERVICE

Every "Buffalo" Fan features the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

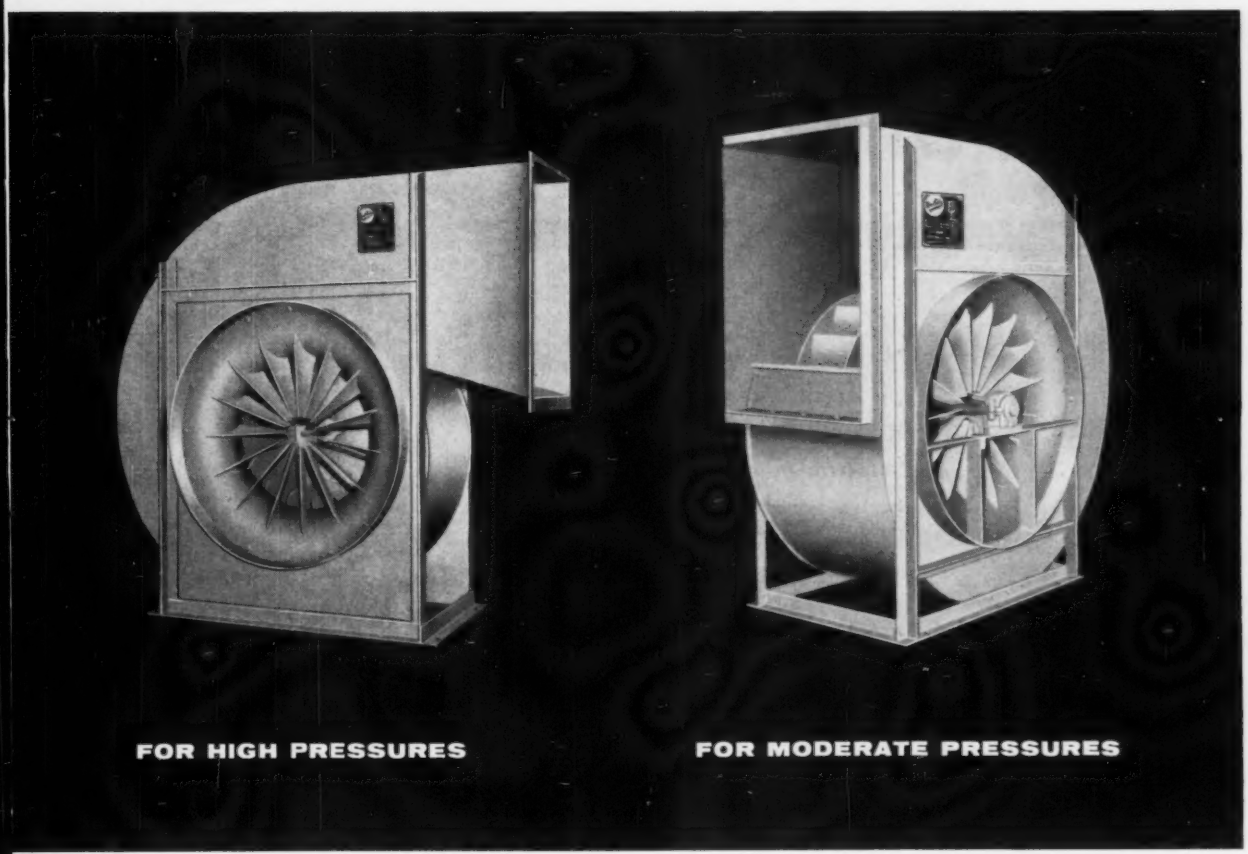
"Buffalo"

CANADIAN

EXACTLY—FOR ALL HEAVY-DUTY AIR MOVING

The "Buffalo" Type "BLH" Fan is unsurpassed for Classes III and IV mechanical draft and ventilating service. A combination of "Buffalo" engineering features insures a new high in performance over a broad efficiency range. The uniquely-designed housing provides smooth, streamlined air flow, extremely high static conversion and excellent pressure distribution at the fan outlet. Distortion-free inlet and smooth, backward-curved wheel blades also contribute to the "BLH" Fan's highly efficient performance and exceptionally stable operation over the entire range from free delivery to shut-off. A long, trouble-free life is assured by the traditionally sturdy "Buffalo" construction features. Write today for Bulletin F-200.

The "Buffalo" Type "BL" Fan is ideally suited for most conditions in Classes I and II mechanical draft service, and central system ventilating applications. High static efficiencies and minimum noise levels result from the unique "Buffalo" all-streamlined design of inlet, rotor and housing. The fixed inlet guide vanes and deep drawn, smoothly-curved inlet bell properly distributes the air flow into the wheel, minimizing inlet shock loss. Backward-curved blades provide the desirable non-overloading horsepower characteristic. Long-lived dependability is insured by such rugged construction features as die-formed and welded components. Write for Bulletin F-102 today.



FOR HIGH PRESSURES

FOR MODERATE PRESSURES

BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

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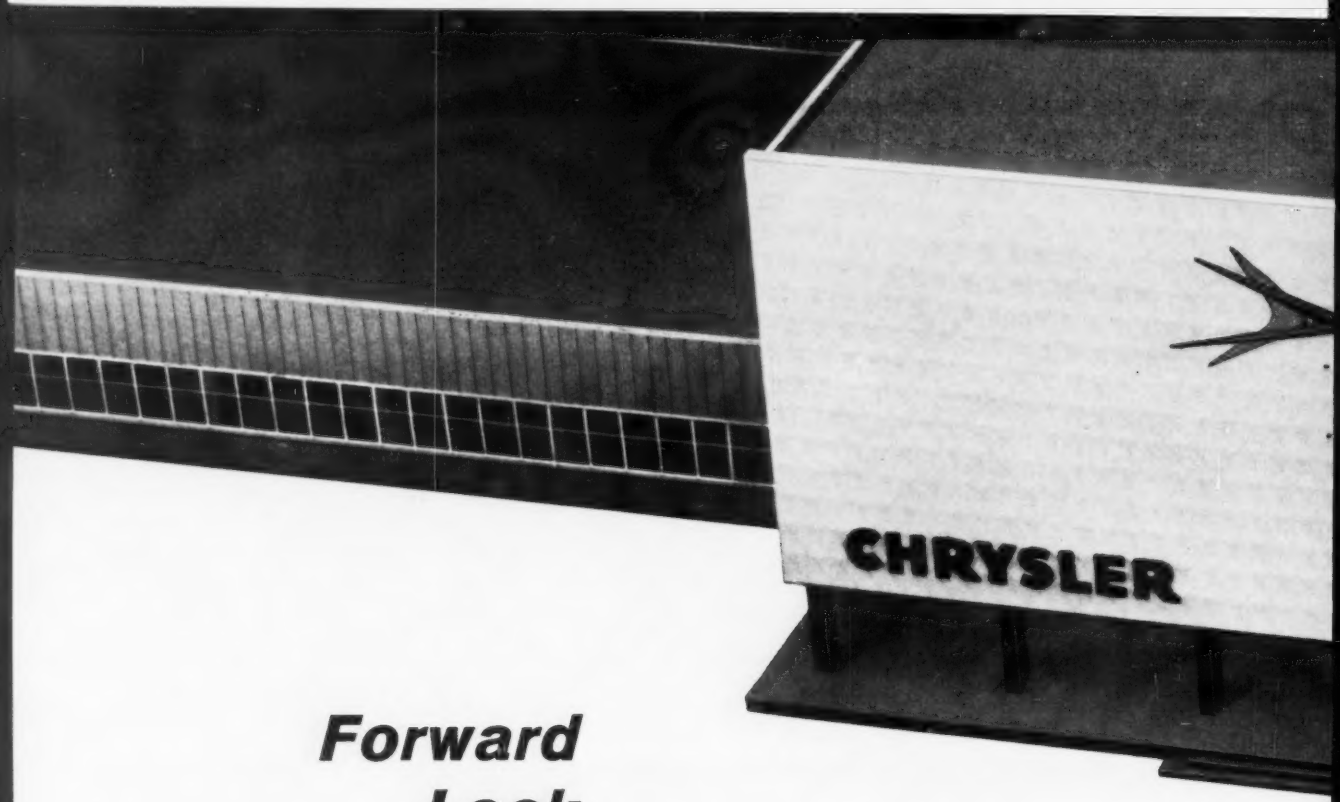
VENTILATING
AIR CLEANING
AIR TEMPERING
INDUCED DRAFT
EXHAUSTING
FORCED DRAFT
COOLING
HEATING
PRESSURE BLOWING

For more facts circle 845 on Reader Service Card p 222



Forward Look in POWER

at Chrysler Stamping Plant with

28 lines of stamping presses are assured uninterrupted electric power by selective schemes

THE enormous load requirements of Chrysler Corporation's new 34-acre stamping plant at Twinsburg, Ohio: power for 260 presses ranging in speeds from ten to thirty strokes per minute; stamping forces up to 1600 tons; welding loads; lighting loads — all are met by the efficient use of primary and secondary substations and primary distribution equipment.

Chrysler engineers, after analyzing the specific requirements of the plant, designed a system which most adequately met the needs for supplying reliable power. Allis-Chalmers switchgear fills the requirements for dependable, uninterrupted service.

The result is a modern power distribution system combining flexibility, reliability and full power for all stamping, welding and lighting loads.

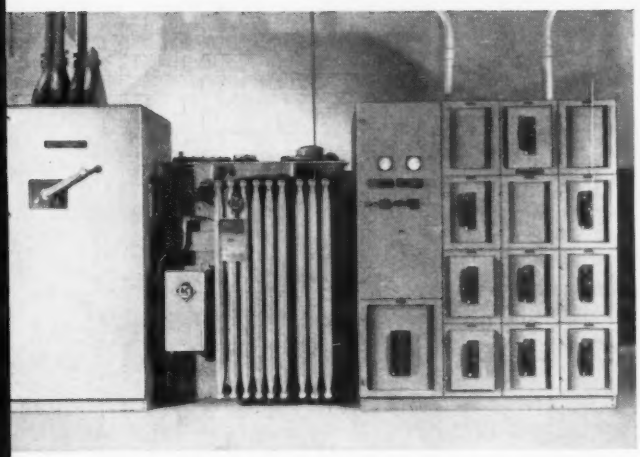
You'll find the answer to all your plant power needs in Allis-Chalmers equipment. Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

All the auxiliary switchgear for a complete power plant—and all of it on a common aisle! This unusual installation includes, from left to right, 480-volt, 2400-volt substations and 13.8-kv switchgear.

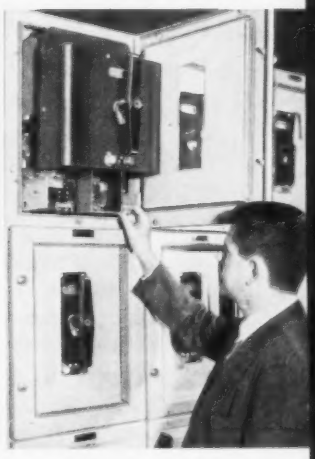
ALLIS-

There are 9000 kva of unit substation equipment in this one room! This equipment was located close to the load center by placing it in a room directly above the production area it serves.

Allis-Chalmers Switchgear



An Allis-Chalmers *First*, the reversible door panel provides breaker storage inside cubicle. Note that three panels are reversed or protruding to provide the additional space in the cubicle for storage of disconnected breaker.



Breaker compartment door swung open showing depth of reversible door panel, eliminating need for extra storage space. Calibrated scales on trip adjusting knobs provide accuracy of settings, action, adjustment and indication.

CHALMERS

A-5764

New Slide Rule Free!

. . . for selecting your air circuit breakers in new secondary unit-sub installations, or checking safety of existing breakers.

Permits accurate and fast calculation of short circuit RMS amperes and interrupting capacity of feeder breakers. Write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

For more facts circle 846 on Reader Service Card p 222

Avoid costly downtime from dirty process water

Clarify it with Celite filtration

PROCESS WATER which contains colloidal color and suspended solids may cause costly downtime or damage expensive plant equipment.

Celite* filtration prevents fouling of resin beds in softeners and demineralizers. It also assures clean, clear water for boiler feed, cooling towers, heat exchangers, scrubbing towers and other process operations where slime, sludge or mud deposits can cause serious trouble.

Celite removes more suspended solids than other types of clarification—even amoebae and algae and most bacteria if required. It operates at fast flow rates with any conventional pressure filter. It comes in 9 standard grades for precise clarity control. And it is low in cost.

A Celite engineer will be glad to study your water problem and offer his no-obligation recommendations. Write Johns-Manville, Box 14, N. Y. 16, N. Y. In Canada, Port Credit, Ont.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

Johns-Manville CELITE
diatomite filter aids

For more facts circle 847 on Reader Service Card p 222

Esso's 80,000 lbs of Alcoa Aluminum jacketing (alloy 3003 sheet) gives all-weather, year-round protection to one 20-in. high pressure steam line . . . two 30-in. low pressure steam lines . . . one 16-in. low pressure line, two 8-in. steam-traced fuel oil lines. Designed by Esso engineers and several consulting firms, the pipeline system joins Bayway Refinery facilities with the Linden generating station of the Public Service Electric and Gas Co. Jacke .ng was applied by the Trybee Co., Inc., Garfield, New Jersey.

Corrosion-resistant Alcoa Aluminum Pipe Jacket helps Esso save $500,000 annually

Light, bright, corrosion-resistant jacketing of ALCOA® Aluminum helps Esso Standard Oil Company save over $500,000 annually. Installed on 5½ miles of large diameter, steam-carrying pipe at the company's Bayway, New Jersey refinery, the aluminum jacketing shields the piping and its insulation from rain, snow, dirt and ice . . . while providing highly effective protection against an industrial-marine atmosphere.

Esso estimates that the insulation with its protective aluminum jacketing has cut pipeline heat loss to just 5% of that experienced with bare pipe. In a year's time, over $500,000.00 would be needed to replace heat lost without such protection. The aluminum jacketing keeps the insulation fully effective by guarding it against weather damage.

Like Esso, you will reap handsome dividends through effective insulation protection and reduced corrosion damage . . . by jacketing your insulated pipelines with light, bright, corrosion-resistant ALCOA Aluminum. For full information, use the coupon or write ALUMINUM COMPANY OF AMERICA, 888-K Alcoa Building, Pittsburgh 19, Pennsylvania.

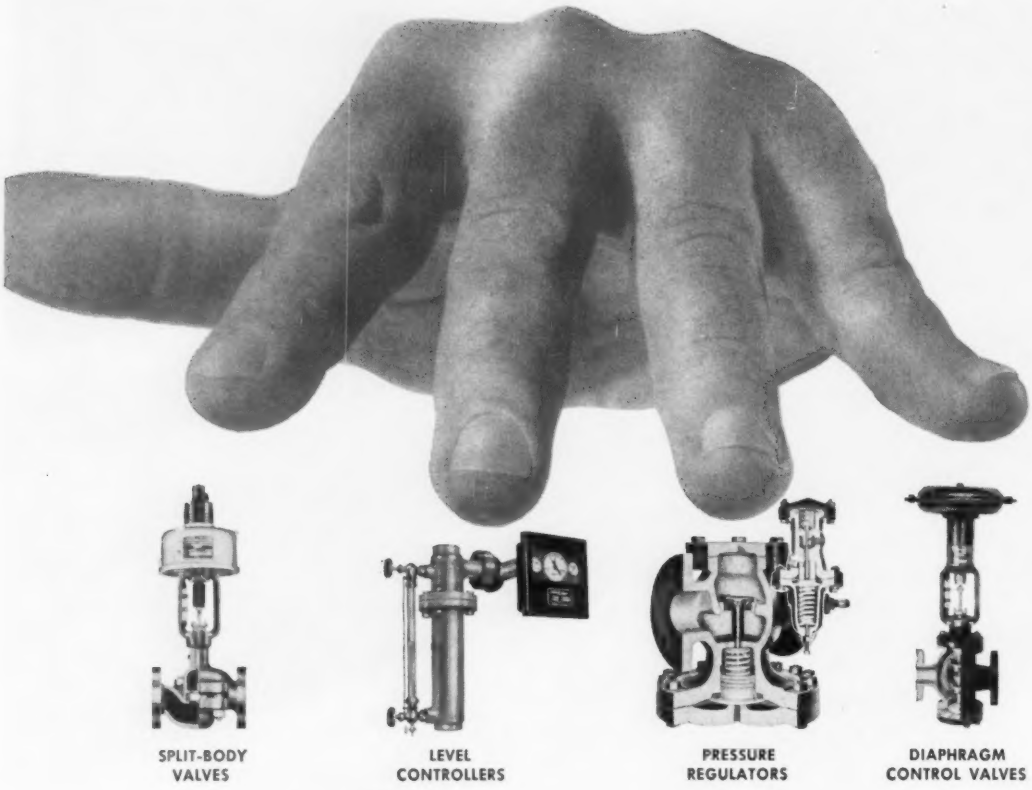
ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

"ALCOA THEATRE"
Exciting Adventure
ALTERNATE MONDAY EVENINGS

Aluminum Company of America
888-K Alcoa Building
Pittsburgh 19, Pennsylvania
Please send me full information on corrosion-resistant Alcoa Aluminum Pipe Jacketing for the following piping services:

Name
Company Title
Address
City Zone State

For more facts circle 848 on Reader Service Card p 222



KEEP A FIRM HAND ON FLUID CONTROL WITH K&M VALVES ALL ALONG THE LINE

From the complete display on the K & M shelf, you can select the best type of valve for every control job in the process line. You can, in fact, standardize entirely on K&M. That means simplified specification, ordering, maintenance.

Especially maintenance. K & M engineers have put consistent design emphasis on field interchangeability of components. In a pinch, you can "borrow" an inner valve or a topworks assembly from a pressure regulator for use with a diaphragm motor valve. That's what we mean by interchangeability.

And because the K & M line is so diverse and inclusive, our field representatives are free to make unbiased suggestions on the type of valve best suited to your requirements. That can often mean substantial dollar savings all along the process line.

THREE TECHNICAL BULLETINS GIVE THE IMPORTANT FACTS AND FIGURES. THEY'RE YOURS FOR THE ASKING.

Bulletin 401 Pressure-Regulating Valves

Bulletin CV53 Standard Diaphragm-Operated Control Valves

Bulletin 132 Split-Body Valves

K&M

diaphragm control valves

KIELEY & MUELLER, INCORPORATED

Our 79th Year

Oldest Pressure and Level Control Valve Manufacturer
64 Genung Street, Middletown, New York

S.A. 1721

After twenty years of standing guard Blaw-Knox Sprinklers save press room... keep paper rolling

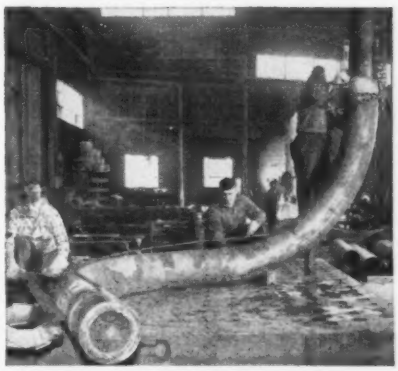
When fire flashed across the 90-foot press room of the Pittsburgh *Post-Gazette* thirteen sprinkler heads opened up to smother the flames. Damage was held to a minimum so that the paper didn't miss an issue. So, after twenty years of 'round-the-clock, watchful waiting, this Blaw-Knox Automatic Sprinkler System prevented a disaster.

Whether fire strikes tomorrow, or in the next twenty years, a Blaw-Knox system starts paying off immediately in reduced insurance payments. And when a fire does occur—and there's a seven to one chance it will hit you this year—your custom designed system detects, confines and quenches the blaze . . . keeps you in business.

Blaw-Knox engineers will gladly study your layout, submit an estimate, and explain the lease and deferred payment. No obligation. For details write for Bulletin 2426.

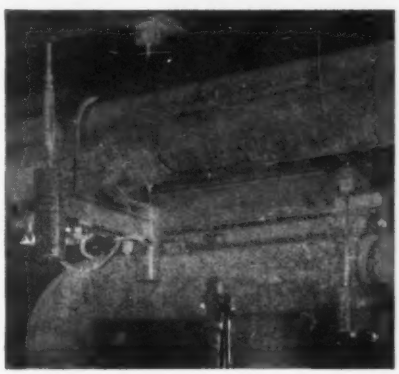
COMPOUND BEND MEETS RIGID TESTS BEFORE SHIPMENT

This 20-foot long, 12-inch diameter seamless steel tubing meets exacting standards for high pressure, high temperature service. Besides outstanding engineering and fabricating facilities, Blaw-Knox provides a digital computer method that speeds your piping stress calculations. Write for details.



UNIQUE INTERNAL SWIVEL PROVIDES TWO-WAY PIPE HANGER CONTROL

This patented action permits movement while hanger case remains vertical. Blaw-Knox offers a complete line of precision-built hangers, supports and vibration eliminators—all furnished as complete units to save engineering time and simplify field assembly. For details write for Catalog 58 today.



BLAW-KNOX

BLAW-KNOX COMPANY

Power Piping and Sprinkler Division

829 Beaver Avenue, Pittsburgh 33, Pennsylvania

For more facts circle 850 on Reader Service Card p 222

A blue chip pump...

ALABAMA POWER COMPANY
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ARIZONA PUBLIC SERVICE COMPANY
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ARKANSAS POWER & LIGHT COMPANY
Little Rock, Arkansas

ATLANTIC CITY ELECTRIC COMPANY
Atlantic City, New Jersey

CENTRAL POWER & LIGHT COMPANY
Corpus Christi, Texas

CINCINNATI GAS & ELECTRIC COMPANY
Cincinnati, Ohio

COLUMBUS & SOUTHERN OHIO ELECTRIC COMPANY
Columbus, Ohio

COMMONWEALTH EDISON COMPANY
Chicago, Illinois

EL PASO ELECTRIC COMPANY
El Paso, Texas

FLORIDA POWER CORPORATION
St. Petersburg, Florida

HOUSTON LIGHTING & POWER COMPANY
Houston, Texas

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Wichita, Kansas

OKLAHOMA GAS & ELECTRIC COMPANY
Oklahoma City, Oklahoma

PENNSYLVANIA ELECTRIC COMPANY
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Manchester, New Hampshire

PUBLIC SERVICE COMPANY OF NEW MEXICO
Albuquerque, New Mexico

ROCKLAND LIGHT & POWER COMPANY
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SAN DIEGO GAS & ELECTRIC COMPANY
San Diego, California

SOUTHERN CALIFORNIA EDISON COMPANY
Los Angeles, California

SOUTHERN ELECTRIC GENERATING COMPANY
Birmingham, Alabama

TEXAS ELECTRIC SERVICE COMPANY
Ft. Worth, Texas

TEXAS POWER & LIGHT COMPANY
Dallas, Texas

TUCSON GAS, ELECTRIC LIGHT & POWER COMPANY
Tucson, Arizona

UNITED ILLUMINATING COMPANY
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in blue chip company!

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Riverside, California

CAROLINA POWER & LIGHT COMPANY
Raleigh, North Carolina

CENTRAL ILLINOIS ELECTRIC & GAS COMPANY
Rockford, Illinois

CENTRAL ILLINOIS PUBLIC SERVICE COMPANY
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CONNECTICUT LIGHT & POWER COMPANY
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CONSUMERS POWER COMPANY
Jackson, Michigan

DALLAS POWER & LIGHT COMPANY
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DELAWARE POWER & LIGHT COMPANY
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LONG ISLAND LIGHTING COMPANY
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MISSISSIPPI POWER COMPANY
Gulfport, Mississippi

NIAGARA MOHAWK POWER CORPORATION
Syracuse, New York

OHIO EDISON COMPANY
Akron, Ohio

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Tulsa, Oklahoma

SOUTHWESTERN GAS & ELECTRIC COMPANY
Shreveport, Louisiana

UTAH POWER & LIGHT COMPANY
Salt Lake City, Utah

PACIFIC Boiler Feed Pumps

BF-27-A

Write For Bulletin 122

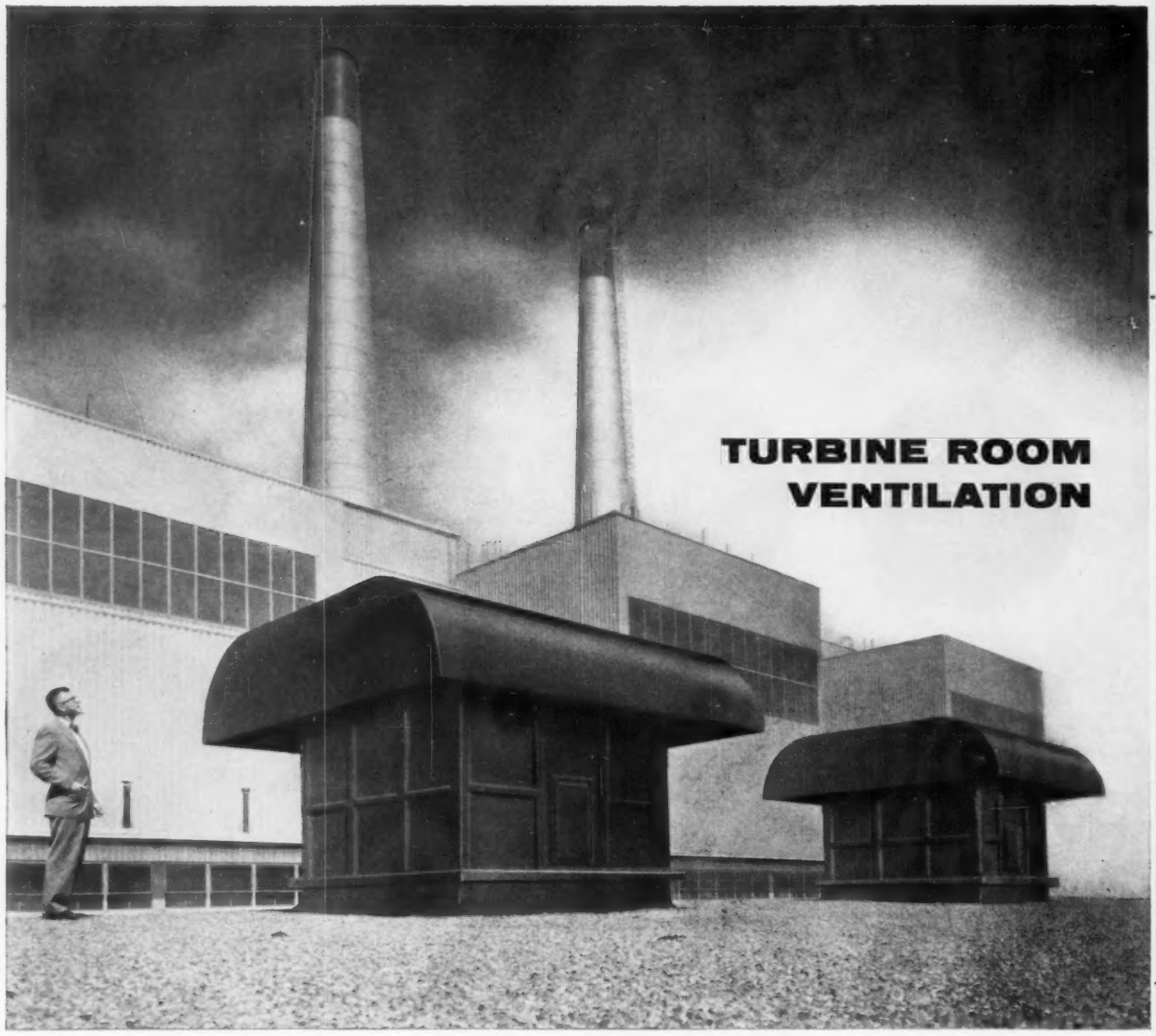
PACIFIC PUMPS INC.

A DIVISION OF DRESSER INDUSTRIES, INC.

HUNTINGTON PARK, CALIFORNIA

PACIFIC

For more facts circle 851 on Reader Service Card p 222

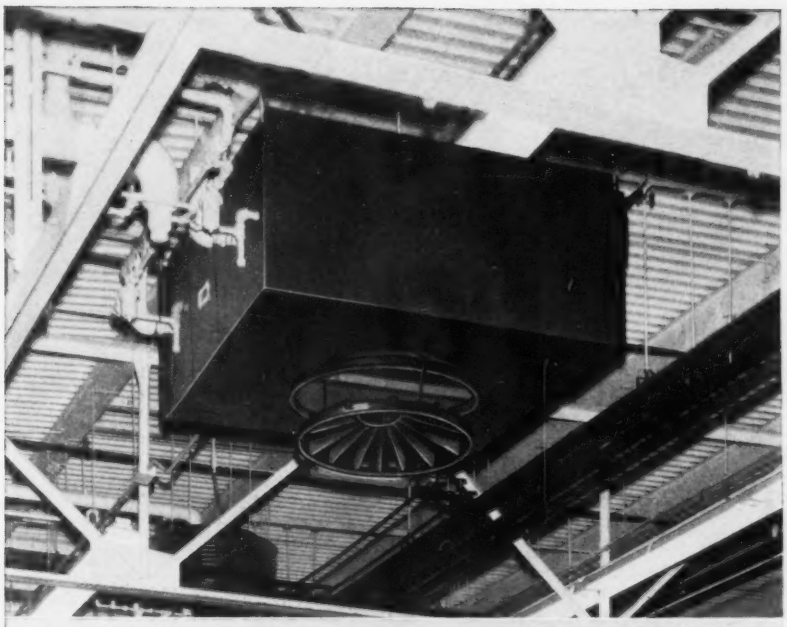


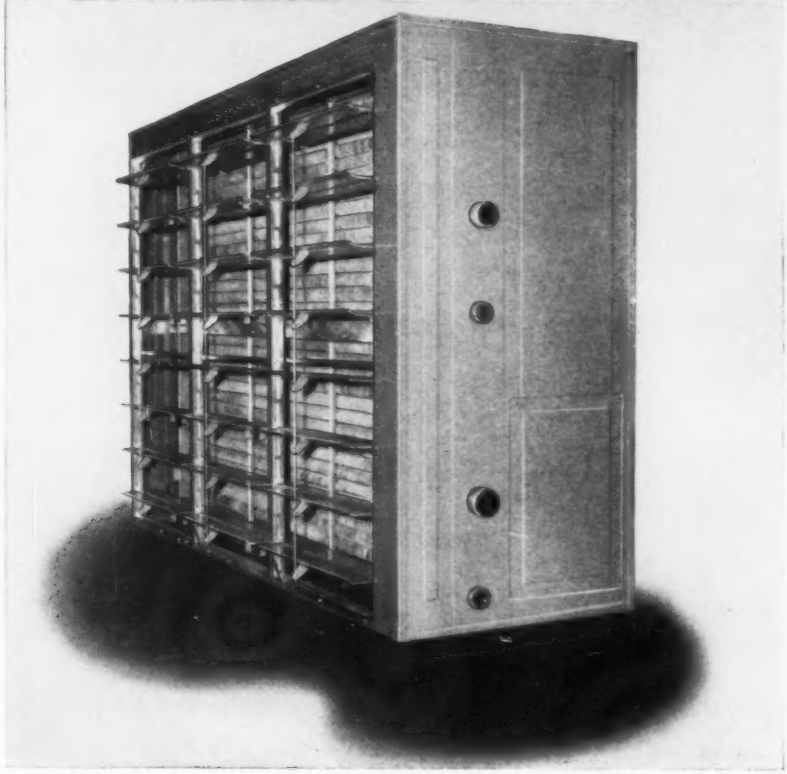
ALL EFFICIENTLY HANDLED WITH "BUFFALO"

Three air handling problems present in modern power plant design can be easily handled with these "Buffalo" package units. **"Buffalo" Power Roof Ventilators** are complete, easy to install packages, including motor drive, in capacities to 250,000 cfm. Utilizing hollow steel tubes, rigid gussets, heavy galvanized sheets and ⅛″ thick cork impregnated asphalt coating inside and out, these units withstand corrosion, heavy snow loads and hurricane force winds. **"Buffalo" Make-Up Air Units** are being used to provide large quantities of heated air to areas housing forced draft fans. These units may include non-freeze coils, motor operated face and by-pass dampers, adjustable diffuser sections and reversible wheels for summer ventilation. May be wall or ceiling mounted. **"Buffalo" Air-Preheaters** are available in a wide range of capacities. Typical "Buffalo" "Q" Factor* construction is used throughout, guaranteeing complete satisfaction on the job.

For additional information, phone your nearest "Buffalo" engineering representative or write direct to the Buffalo Forge Company.

*The "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.





- - - MAKE-UP AIR AND AIR PREHEAT

PACKAGE UNITS

Left: two of four "Buffalo" Power Roof Ventilators over turbine room at the Detroit Edison Company's River Rouge Station. Sixteen more have been ordered.

Above: typical "Buffalo" Make-Up Air Unit, may include heating coils, filters, diffusers, dampers and reversible wheels.

Below: "Buffalo" Air Pre-Heaters are available in a wide range of capacities, offer low air loss.

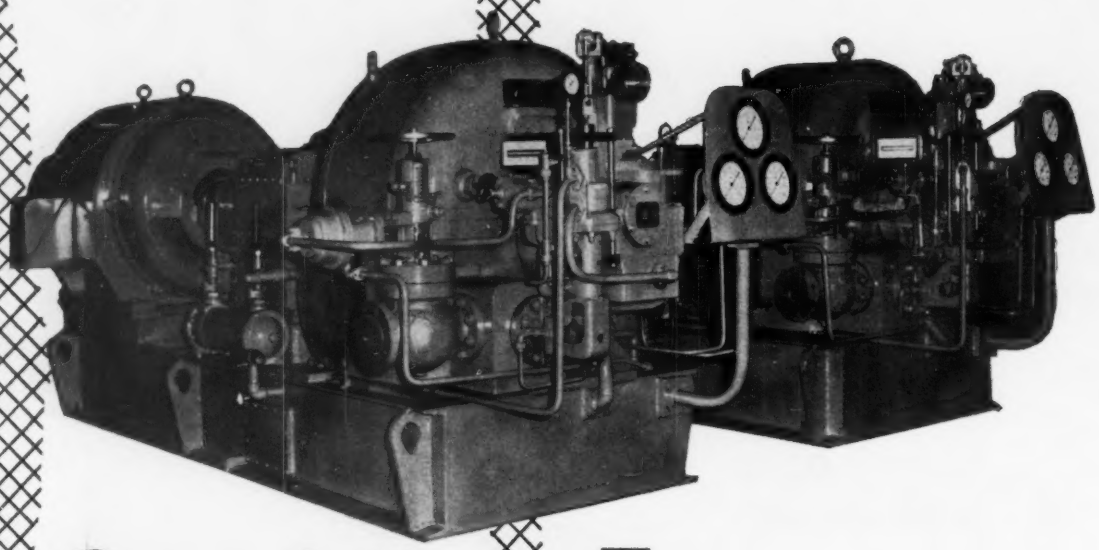
BUFFALO FORGE COMPANY
Buffalo, New York

Buffalo Pumps Division, Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING
FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

For more facts circle 852 on Reader Service Card p 222



Dependable LOW COST Power PACKAGE FOR THE SMALL PLANT

This pair of 200 KW Murray Turbine generators supply constant, around-the-clock electrical power in a mid-western plant.

The Murray Design 75 — 400 KW Turbine generator sets provide all the safety and economy features of the most modern larger designs — and at the same time offer the advantage of low initial cost and maintenance.

Murray Turbine generator sets can also be furnished in ratings from 500 KW to 3,000 KW. Your Murray Representative will give you details. Write for his name today.

Murray TURBINES

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA

Builders of Steam Power Equipment for Nearly a Century

For more facts circle 853 on Reader Service Card p 222

IN SRE... Zallea expansion joints absorb thermal expansion of reactor core tank and outer tank

The very nature of the Sodium Reactor Experiment, conducted by Atomics International for the AEC, and the method of handling the liquid sodium reactor coolant demand reliability in expansion joints. Because of the operation there can be no compromise in design or quality.

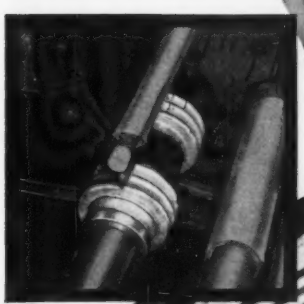
The high temperature SRE uses Zallea Expansion Joints where thermal expansion must be absorbed and where a gas seal must be maintained. An 11-ft. diameter Zallea Expansion Joint at the top of the outer tank absorbs the expansion that results from the temperature increase in these components as the reactor comes up to operating temperature, 960°F. In addition, the expansion joints form a seal for the helium gas and sodium vapor above the sodium pool at the top of the reactor as well as for the helium gas within the outer tank.

In the sodium coolant piping circuit gas seals are effected by means of Zallea Expansion Joints in the region where the pipes leave the reactor cavity and enter the pipe galleries.

Zallea has worked with almost every major engineering and manufacturing firm engaged in atomic, nuclear and missile work—and has provided the large majority of expansion joints for such projects. As a result, we have accumulated a store of expansion joint engineering data and manufacturing skills that cannot be equalled. Whenever expansion is involved in piping systems, reactors, tanks—whatever the application—let our engineers work with you. We already have the answer to many of the difficulties you will encounter. And we welcome the chance of tackling your problem.

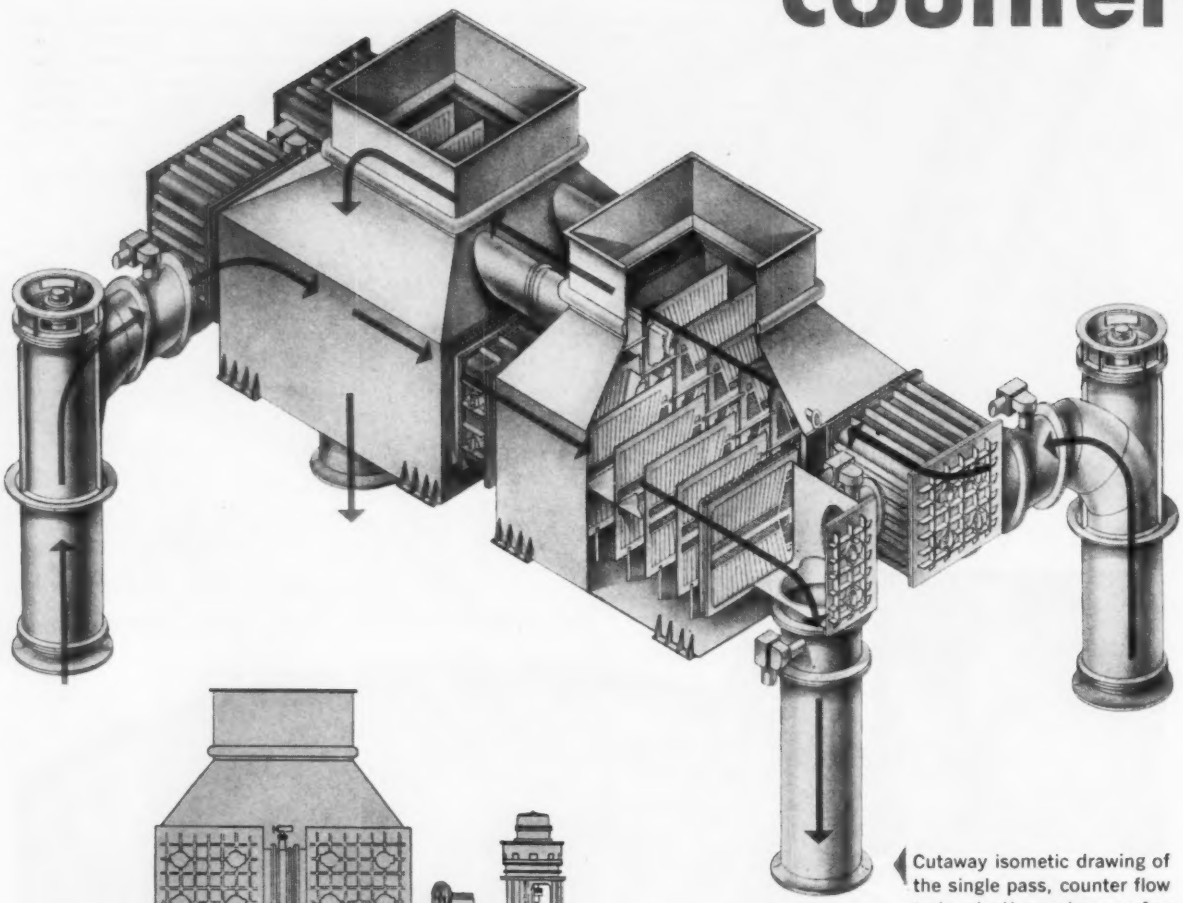
Zallea
expansion joints

ZALLEA BROTHERS, Wilmington 99, Del. • World's largest manufacturer of expansion joints

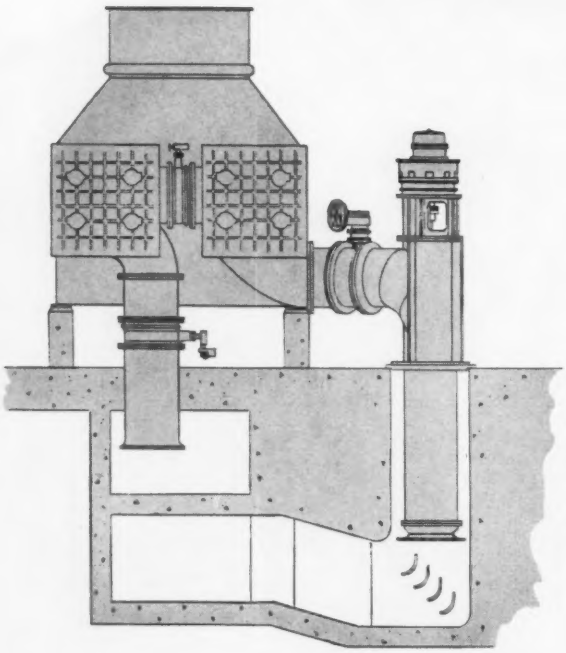


For more facts circle 854 on Reader Service Card p 222

New FW single pass, counter



Cutaway isometic drawing of the single pass, counter flow twin shell condenser for Barry Steam Plant, showing water flow during normal full load operation.



General cross section at pump intake. Foster Wheeler also supplied the two vertical, mixed flow circulating pumps, each designed for 80,000 gpm at 20 ft TDH; and the three horizontal, 5-stage double suction condensate pumps, each rated 1500 gpm at 565 ft TDH.

FOSTER

NEW YORK • LONDON • PARIS

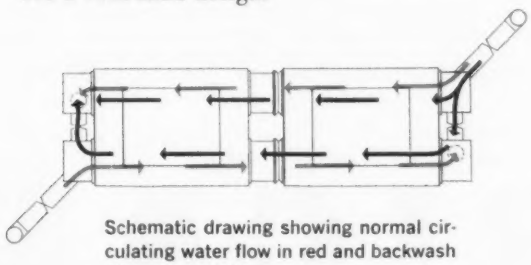
flow condenser

offers these important advantages for Alabama Power Company's Barry Steam Plant

- **LOW COST**
- **BALANCED BACK PRESSURE**
- **SIMPLIFIED BACKWASHING**
- **FLEXIBILITY OF OPERATION**

THE NEW Foster Wheeler single pass, counter flow condenser was specifically designed to meet the unusual conditions imposed by Alabama Power Company and Southern Services, Inc., Engineers, in laying out a plant extension for Alabama's Barry Steam Plant, Unit No. 3.

By the application of the established principles of Foster Wheeler condenser design, a most economical arrangement for a twin bottom-exhaust turbo-generator set with tubes at right angles to the turbine shafts was provided. It features short tube lengths, complete back washing and a minimum number of waterboxes for a twin-shell design.



Schematic drawing showing normal circulating water flow in red and backwash of one side in black.

Backwashing of the tubes and tube sheets is obtained with only six valves, two of which are the normal circulating pump shut-off valves. This valving arrangement also allows the complete condenser to be operated at light loads with only one circulating pump.

Serving the 225,000 kw turbine for Unit No. 3, the Barry Steam Plant condenser has 150,000 sq ft of tube surface, with 23,876 1-inch tubes having an effective length of 24 ft. It is designed to maintain 1.92″ Hg back pressure when condensing 1,100,000 pounds of steam per hour with 160,000 gpm of 80F cooling water.

Foster Wheeler is continually working toward the improvement of condenser designs for higher efficiencies and greater economies of installation and operation, such as described above. We would welcome the opportunity to be of service to you.

For further details on this installation, send for the July 1958 issue of Heat Engineering. *Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, New York.*

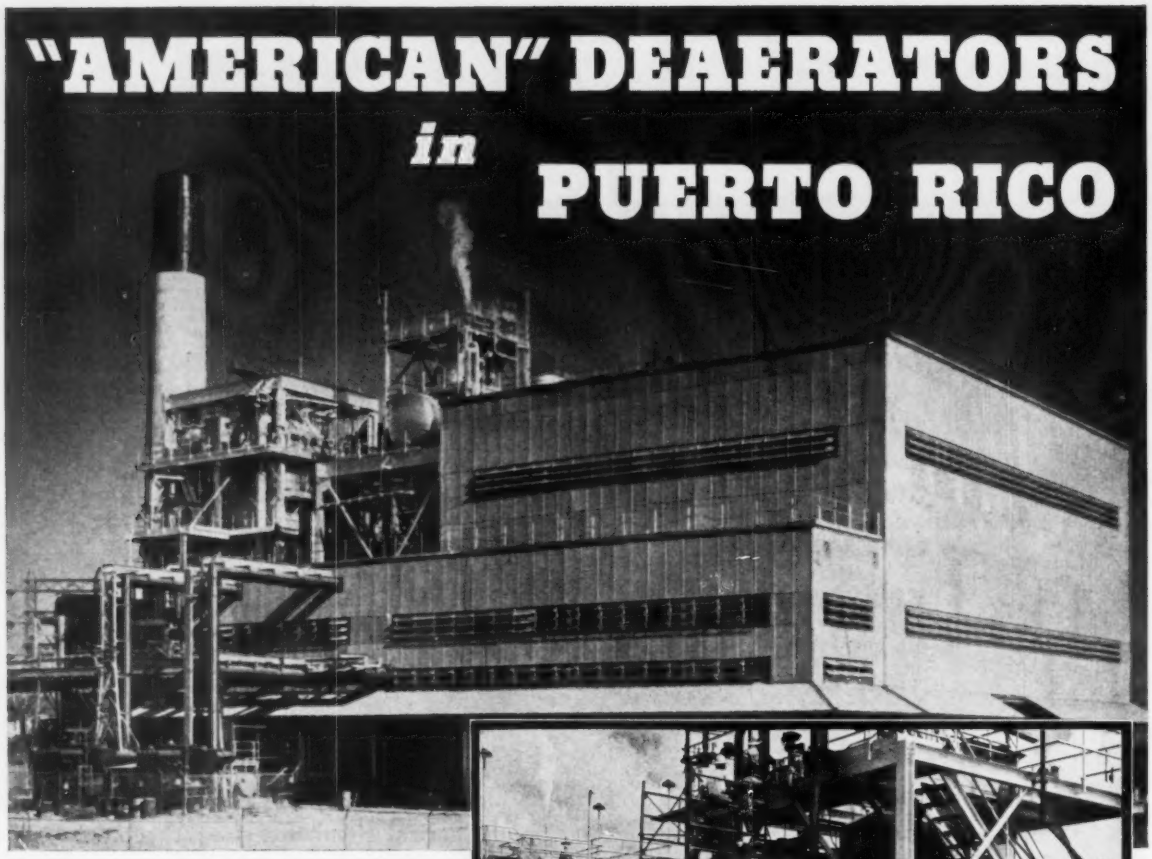
WHEELER

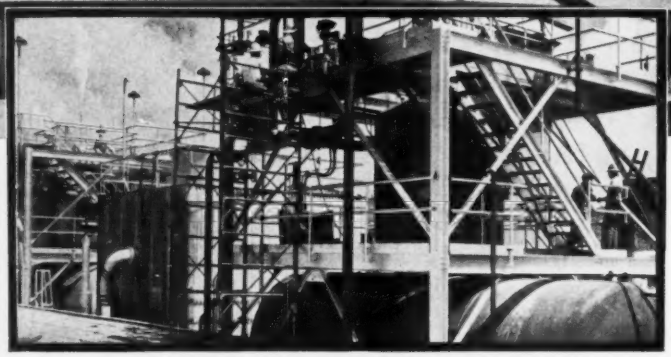
ST. CATHARINES, ONT.

STEAM GENERATORS · SURFACE CONDENSERS
FEEDWATER HEATERS · COOLING TOWERS
ECONOMIZERS · COAL PULVERIZERS

For more facts circle 855 on Reader Service Card p 222

"AMERICAN" DEAERATORS *in* PUERTO RICO





PUERTO RICO WATER RESOURCES AUTHORITY
SOUTH COAST STEAM-ELECTRIC GENERATING STATION
PEÑUELAS • P. R.

Two tray type Deaerators, each with a capacity of 500,000 lbs/hr., are installed in this modern generating plant, providing feedwater of zero oxygen purity to the boilers. Two more such Deaerators, each with a capacity of 720,000 lbs/hr. have been ordered. Designed and built by American Water Softener Company, all four Deaerators are as modern and efficient as the great generating station they serve.

For over 56 years, American Water Softener Company, oldest engineering/manufacturing organization in this country devoted exclusively to water conditioning, has designed and constructed softening and filtering plants, deaerators, demineralizers and other water conditioning equipment for industrial and utility plants, both here and abroad. *Literature describing American Water Conditioning Equipment will be sent on request*

SINCE 1902

AMERICAN
WATER SOFTENER COMPANY, Inc.

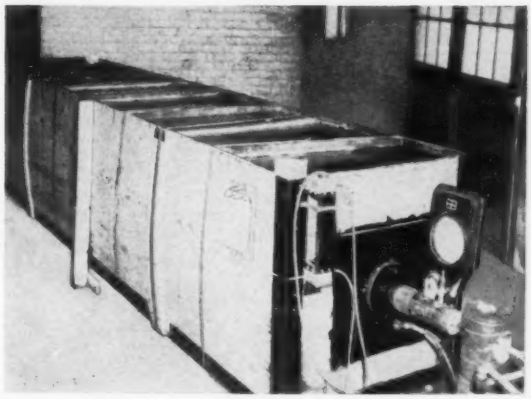
FOURTH STREET AND LEHIGH AVENUE • PHILADELPHIA 33, PA.

DEAERATORS · HOT PROCESS SOFTENERS · ZEOLITE SOFTENERS · DEMINERALIZERS · FILTERS

for users of underground piping systems...

Now... for the first time, basic principles used by RIC-WIL for decades are supported by extensive independent research. These principles are brought out in Technical Reprint #16, issued as a compilation of the results of a survey by the Building Research Advisory Board, of the National Academy of Sciences and tests made by the National Bureau of Standards. These criteria are also the basis of new Guide Specifications issued by several Federal Agencies, all of which include the basic principles of RIC-WIL Prefabricated Insulated Piping Systems. This survey is of such magnitude that it required over 2,000 man-hours and some 2,500 pages of documents and tests.

All tests of a conduit system required by the survey and specifications have been completed by RIC-WIL and an approved independent testing laboratory has certified that RIC-WIL Systems comply. Write, wire or phone for complete information.



Part of test equipment built by RIC-WIL in QUALIFICATION TEST PROGRAM.

Ask for RIC-WIL *Catalog on complete line of systems available.*

Quality Piping Systems...
... of Exceptionally High Thermal Efficiency

SINCE 1910

RIC-WIL INCORPORATED — PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED

See our catalog in Sweet's and Engineers' Product File

For more facts circle 857 on Reader Service Card p 222

OVER 50 LimiTorque VALVE OPERATORS ARE USED

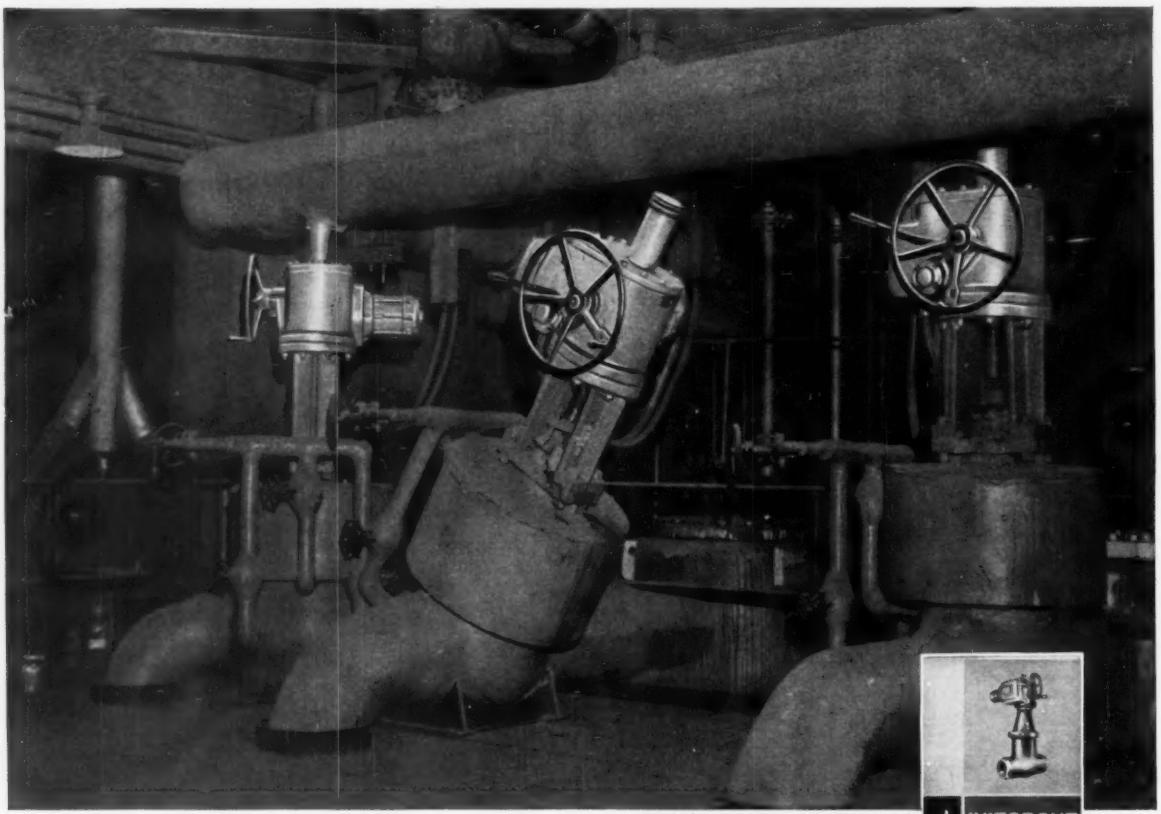
. . . in the East River Generating Station of Consolidated Edison Co.

The illustration below shows three LimiTorque Motorized Valve Operators used on 12″ water inlet valves to high pressure feed water heaters . . . there are nearly fifty other LimiTorque Operators used throughout this modern station for various high pressure purposes, on valves ranging up to 20″ diameter. We are proud that this modern generating station, like numerous others throughout the world, has chosen LimiTorque Motorized Operators to control their important valves—speedily, safely, surely and economically.

LimiTorque Valve Controls can be mounted on any size valve in nearly any position or location, and they can be readily adapted to existing equipment with electricity, hydraulic pressure, air or high pressure natural gas used as power sources.

LimiTorque provides constant seating thrust . . . assuring an absolutely tight valve on each closure while at the same time, protecting all valve operating parts from overload. Adjustment of the torque limit switch enables operating personnel to compensate for valve wear throughout the life of the valve.

Contact your valve manufacturer, or nearest LimiTorque sales-engineering office.



Send for complete Catalog L-550, and please use your Business Letterhead when requesting a copy.

THERE IS NO SUBSTITUTE FOR —

LimiTorque®

PHILADELPHIA GEAR CORPORATION

ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

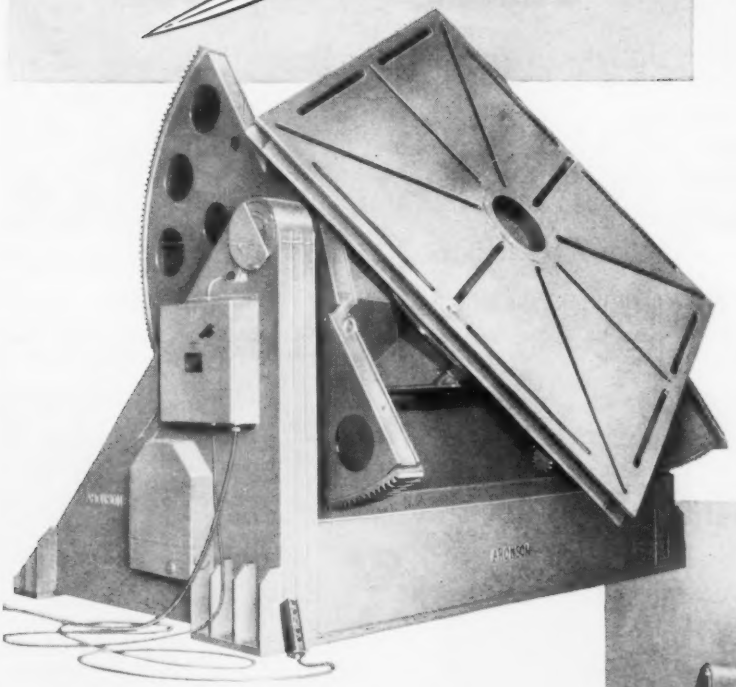
Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS

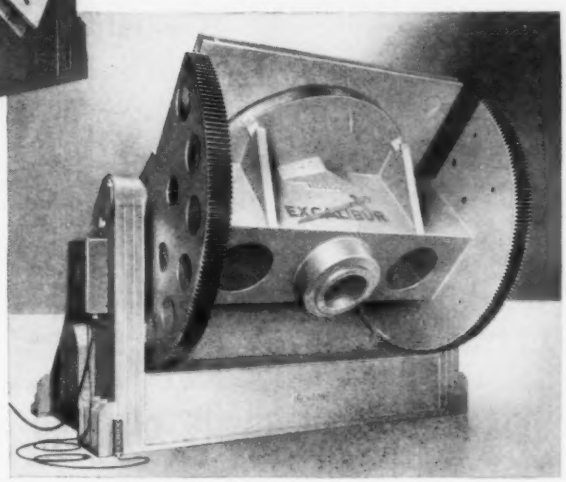
Limitorque Corporation • Philadelphia

For more facts circle 858 on Reader Service Card p 222

EXCALIBUR..... the HIGHEST LOAD CAPACITY Welding Positioner EVER BUILT



Aronson
MODEL G 3500



"EXCALIBUR" is rated 350,000 pounds Load Capacity with CG 12" above table and 6" off-center.

FOUR SELECTIVE VARIABLE SPEED RANGES obtained from the 4-speed gearshift transmission driven by 15 hp Varidrive afford far greater choice of variable rotation speeds. In High Gear top speed is .4 rpm adjustable to .07 rpm. This exceptionally high rotation speed permits automatic welding at high travel rate on diameters as small as eight inches! Then, for larger diameters shift into 3rd Gear and use the .23 rpm to .04 rpm range. Or, still larger work may require 2nd Gear's .13 rpm to .023 rpm range. Largest weldments are profitably rotated in Low Gear range's .08 rpm to .013 rpm.

"EXCALIBUR" is not physically tremendous, being only 88" from floor to horizontal rotation axis, which allows working both large and small weldments without needing excessive headroom and without working too high above the floor.

"EXCALIBUR" has been designed to handle almost every kind of weldment at lowest possible shop cost.

Owning "EXCALIBUR" opens production doors to you that are closed to your competitors. It is NOT a special job machine, but a Welding Positioner that will handle 90% of your jobs that are as small as a ton or so to as large as 175 tons!

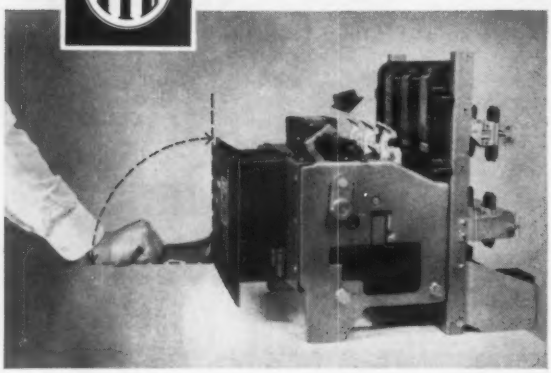
Owning **"EXCALIBUR"** lets you weld automatically those jobs you now wrestle around the shop floor with the profit-eating crane and have to weld manually.

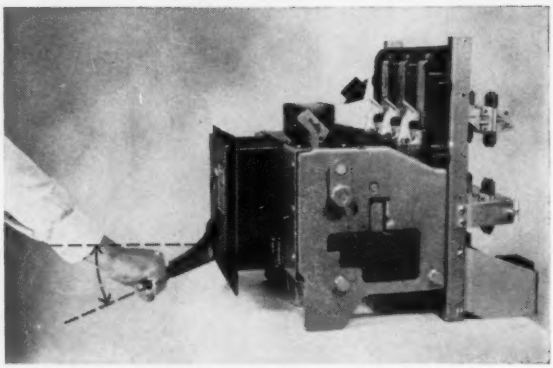
With **"EXCALIBUR"** in your list of machine tool facilities you not only can underbid competition but can assure the award of the contract because your customer will know you have the facility to handle his work.

Quality POSITIONERS by **Aronson MACHINE COMPANY**
ARCADE, NEW YORK

For more facts circle 859 on Reader Service Card p 222

K-LINE LOW VOLTAGE SWITCHGEAR





Only I-T-E has manual quick-make operation available in 225 through 1600 amp rating

Only handle moves. Contacts are static during first 90% of pulldown handle travel. In this picture, arc chutes are removed.

Too fast for the eye. When stored energy mechanism passes crossover point, energy is released to close contacts within 5 cycles.

Only I-T-E has doors closed in all positions while racking

With breaker connected. Both power and control separable contacts are engaged.

In test position. Power contacts disconnected —control contacts connected.

Completely disconnected. Both power and control contacts fully disconnected.

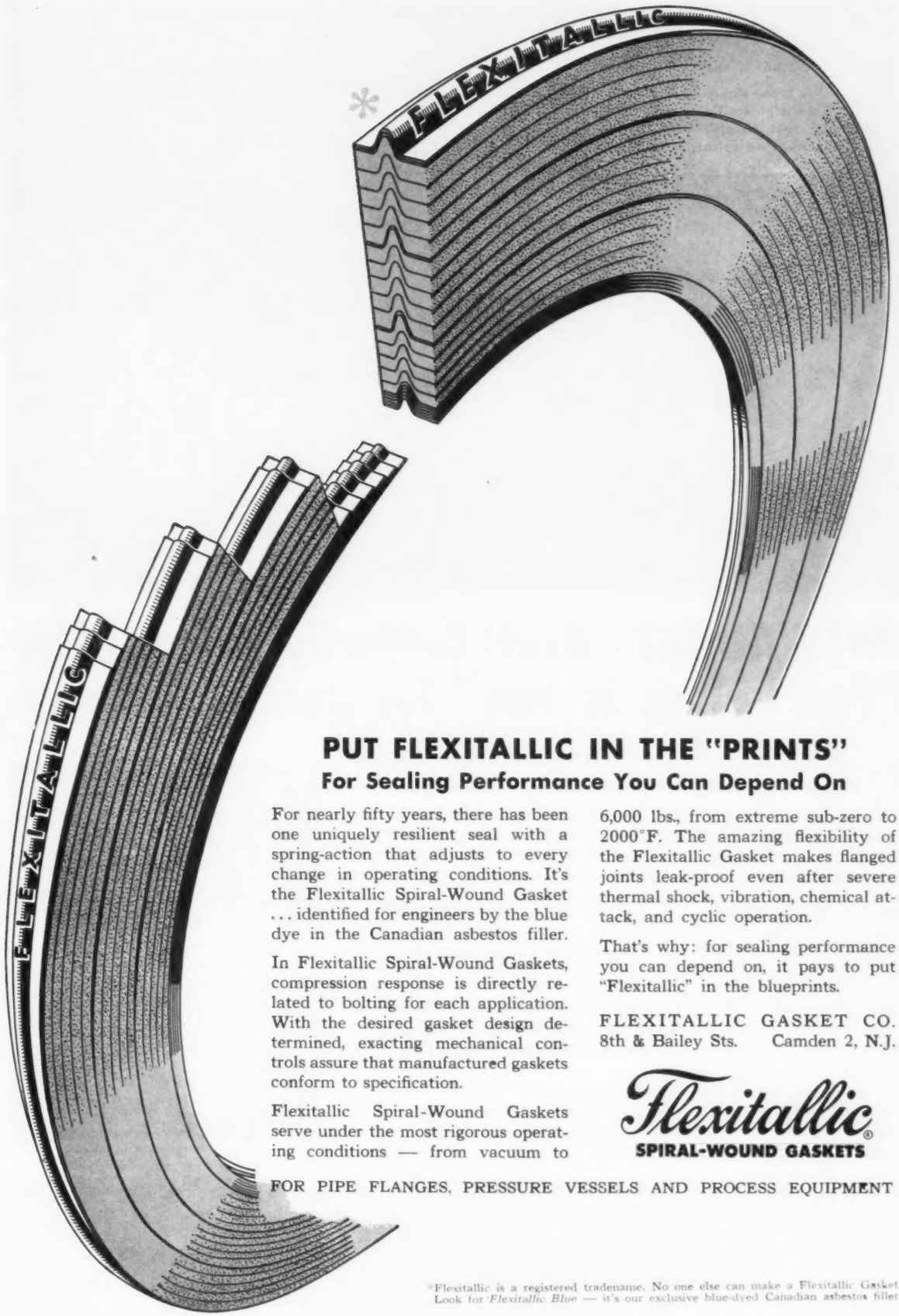
Quick-make, manually charged closing feature and drawout with doors closed provide maximum safety for operator and circuit breaker

You can't tease and burn the contacts of the new quick-make K-Line of circuit breakers—the closing action is fast and positive. An ingenious stored energy mechanism does the job. It stores energy in the first 90% of the pulldown handle travel, releases it in the last 10%. Not until the crossover point is reached do the contacts move. And it closes in only 5 cycles—provides uniform closure every time. *More important, it is the only manually charged stored energy circuit breaker available that will close and latch against its short-time rating.* This means greater safety for the operator, less maintenance, and longer contact life.

You don't have to open the door to move the circuit breaker to test or disconnected position. The crank which operates the simple drawout mechanism fits into the escutcheon through a lift shutter. The shutter cannot be lifted while the breaker is closed. The breaker cannot be closed while the shutter is lifted. This means more than greater safety—you can forget the dirt problem; the nuisance of open doors impeding aisle travel; the risk of circuit breaker damage from exposure, even when completely out of service.

Bulletin 6004-C gives complete information about the new and safer I-T-E K-Line of low voltage switchgear. Contact your nearest I-T-E sales office for a copy. Or write Switchgear Division, I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

I-T-E CIRCUIT BREAKER COMPANY
PHILADELPHIA, PENNSYLVANIA



PUT FLEXITALLIC IN THE "PRINTS"

For Sealing Performance You Can Depend On

For nearly fifty years, there has been one uniquely resilient seal with a spring-action that adjusts to every change in operating conditions. It's the Flexitallic Spiral-Wound Gasket . . . identified for engineers by the blue dye in the Canadian asbestos filler.

In Flexitallic Spiral-Wound Gaskets, compression response is directly related to bolting for each application. With the desired gasket design determined, exacting mechanical controls assure that manufactured gaskets conform to specification.

Flexitallic Spiral-Wound Gaskets serve under the most rigorous operating conditions — from vacuum to 6,000 lbs., from extreme sub-zero to 2000°F. The amazing flexibility of the Flexitallic Gasket makes flanged joints leak-proof even after severe thermal shock, vibration, chemical attack, and cyclic operation.

That's why: for sealing performance you can depend on, it pays to put "Flexitallic" in the blueprints.

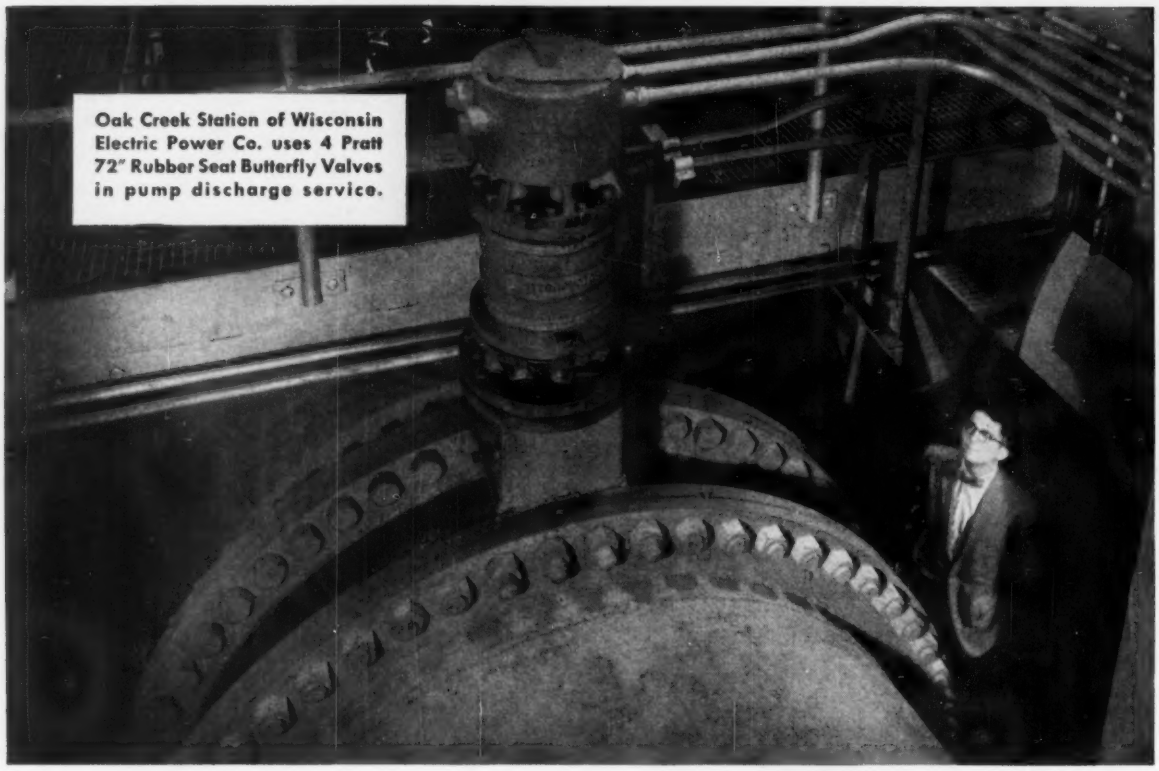
FLEXITALLIC GASKET CO.
8th & Bailey Sts. Camden 2, N.J.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered tradename. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

For more facts circle 861 on Reader Service Card p 222



Oak Creek Station of Wisconsin Electric Power Co. uses 4 Pratt 72" Rubber Seat Butterfly Valves in pump discharge service.

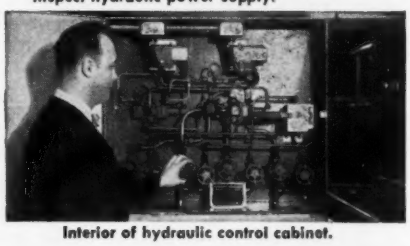
MILWAUKEE...Pratt Butterfly Valves offer "two valves in one" for pump discharge

Pratt Rubber Seat Butterfly Valves in pump discharge service can be made to open and close in synchronization with pump operation, AND they close drop tight—combining, in a single valve, the functions normally achieved by separate shutoff and check valves. The simple combination of disc, shaft and efficient closure provides years of dependable performance without maintenance problems.

Pump discharge valves at Oak Creek Power Plant are hydraulically operated with oil motors. The electro-hydraulic system includes a bank of accumulators and complete auxiliary manual controls to permit operation under any emergency condition.

Pratt pioneered the use of rubber seat butterfly valves in power plants, and today offers the greatest aggregate experience on butterfly valving in the power field. For valve design—**with imagination**—see Henry Pratt.

Felix Kazmerchak, Ass't. Plant Engineer, and Ray F. Egebrecht, Pratt Representative, inspect hydraulic power supply.



Interior of hydraulic control cabinet.

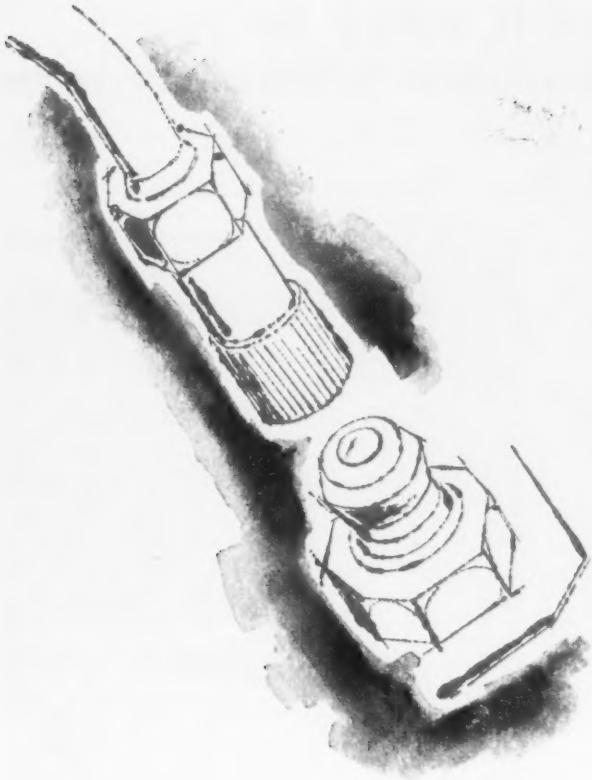
Have you sent for your copy?...of Pratt's 40 page **Manual of Rubber Seat Butterfly Valves.** Useful—contains latest pressure drop and flow data, conversion tables, butterfly valve theory and application. CATALOG B-2K

HENRY PRATT

RUBBER SEAT Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

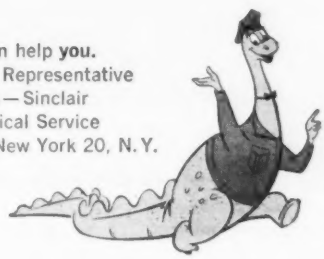
For more facts circle 862 on Reader Service Card p 222



Machinery... lubrication... and how to save money

Sinclair Litholine® multi-purpose grease gives many important advantages over ordinary industrial lubricants. For example, it eliminates the need for a variety of single-use greases. Furthermore, it has earned a reputation for water resistance and high temperature performance. Change to Litholine, now. And when management asks how you've cut costs, tell them you've switched to Sinclair—and show them the results.

Find out how Litholine can help **you.** Call your nearest Sinclair Representative or write for free literature—Sinclair Refining Company, Technical Service Division, 600 Fifth Ave., New York 20, N.Y. There's no obligation.



SINCLAIR
Litholine®
Multi-Purpose Grease

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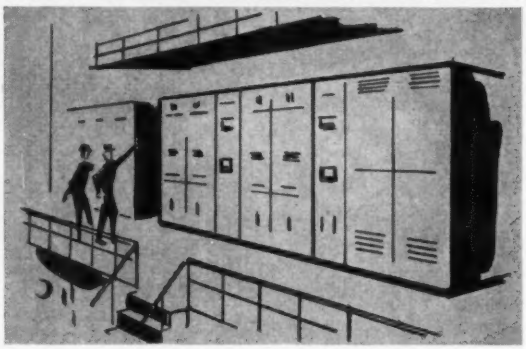
Here's why it pays to Specify Silicone Insulated Transformers

A New Level of Performance for Power Station Auxiliaries

Insulated with silicones, dry-type transformers are so completely safe, you can locate them almost anywhere. Easier and less costly to install than liquid-filled types, they require no vaults, barriers or ventilating fans. And when installed, they offer the best assurance of uninterrupted power because Dow Corning Silicones mean extra overload capacity . . . superior resistance to high ambients, moisture and contaminated atmospheres. Here's how to select the dry-type transformer most suited to your needs —

for maximum reliability, minimum maintenance

Specify a silicone-insulated *sealed* dry-type transformer. With core and coils sealed in an atmosphere of nitrogen, these units have no liquids to maintain . . . require only a periodic check of pressure gauge and bushings . . . are virtually maintenance-free.

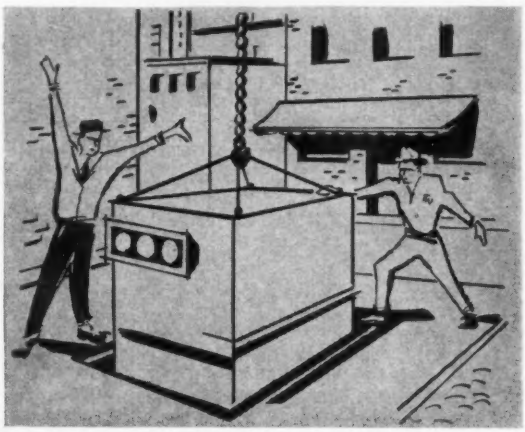


for minimum weight

Specify a silicone-insulated *open* dry-type transformer. Lighter by 15% than the next lightest type, these units are ideal for balconies and other areas where minimum floor loading is a must.

A New Level of Performance for Underground Distribution Systems

Silicone-insulated, nitrogen-filled *network* transformers require so little upkeep, they can be buried and virtually forgotten. They are undamaged even when flooded. Only the bushings, pressure gauge and case require periodic inspection. Dry-type transformers fit easily into existing vaults; are completely safe even in case of extreme overloads or short circuits.



Send today for your copy of new brochure detailing how you can save with silicone insulated dry-type transformers. Includes up-to-date list of manufacturers offering equipment insulated with Dow Corning Silicones.

Address Dept. 6910

first in silicones

Dow Corning CORPORATION

MIDLAND, MICHIGAN

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS DETROIT LOS ANGELES NEW YORK WASHINGTON, D. C.

For more facts circle 864 on Reader Service Card p 222

Hall Industrial Water Report

VOLUME 6 OCTOBER 1958 NUMBER 5

Drought Ends in Dry Southwest

Long-overdue rains have brought desperately needed water to the southwest mining industry. With water supply less critical, mine operators can breathe easier. But the abundance of water does not mean that they, or operators of any industry using water, can be less vigilant in treating the water for service, cooling, boilers, process or waste.

Hall Engineers are particularly helpful when water is at its worst. However, their services are just as important when more and better water is available. Even the best water usually requires treatment to avoid problems such as turbidity, scale, corrosion, foaming or biological slimes. Water can always cause trouble.

Softener Bypassed

The feedwater for a waste-heat boiler at a southwestern smelter is zeolite softened and then dealkalized by ion exchange. Tests showed the treated water to be normally soft and free of brining solution.

These apparently good conditions were belied by excessive phosphate consumption and by the presence of a lot of sludge in the boiler. Further testing revealed that the dealkalized water was almost one-half as hard as the raw water.

Together with the operating men, Hall Engineer J. F. Nelson made a thorough search for the source of the hardness. The "leak" was found to be an open valve in a bypass pipe around the zeolite softener. The valve had been opened when a temporary demand for water had exceeded the softener capacity and had not been closed.

With the valve closed, phosphate consumption dropped to its normal level. Nelson recommended installation of another zeolite softener so there will never be any need to open the valve in the bypass line.

Tailoring Water

A Pennsylvania manufacturer of mining tools operates electric induction furnaces cooled with well water high in temporary hardness and iron. The water also contains a lot of hydrogen sulfide—enough so that employees carried drinking water from their homes to avoid the bad taste and odor of the plant water.

Use of the poor quality water resulted in accumulation of deposits in the furnace cooling coils. The furnaces had to be shut down for cleaning about every second week.

When Hall Engineer D. C. Altenburger reviewed the situation with plant personnel he recommended the addition of Calgon® to the water at each well. Also chlorination of the mixed water to destroy the hydrogen sulfide.

Now, after several months, no cleaning of furnace coils has been necessary. The water no longer has an odor and employees can drink it at the fountains.

Boiler Damage Prevented

After trying unsuccessfully for three days to reestablish satisfactory boiler water conditions following a sudden large increase in dissolved solids and disappearance of phosphate and alkalinity, a Michigan salt refinery called on Hall Engineer C. H. Turner for help. On arriving at the plant he found that feedwater composition was normal but boiler water conditions were intolerable.

Turner's first acts were to open wide the continuous blowdown, arrange for hourly opening of main blowoff valves and start feeding large quantities of phosphate and caustic soda. Seven hours later, conditions were nearly back to normal.

The next move was to determine the source of the trouble. This wasn't easy because no one had noted anything out of the ordinary except the change in boiler water conditions. About 3:30 a.m., when almost everyone had gone home, Turner talked with the janitor, who knew nothing about the trouble but did furnish the vital clue. He recalled that the turbo-generator had been out of service for a short period a few days before. Turner reasoned from this that steam pressure on the salt pans had dropped low enough to permit gross contamination of condensate by inleakage of salt brine high in calcium chloride.

The steps taken prevented damage to the boiler so the only cost to the plant was the extra chemicals required. Profiting by this cheap warning, the plant has made changes to prevent a recurrence of the difficulty. Leaks in the salt pans have been repaired and devices have been installed to detect any further contamination of condensate.

Nitrogen Capping

Some standby boilers must be kept filled with water, ready for service. Chemical treatment protects the surfaces contacted by water. However, protecting superheaters and reheaters from corrosion is more difficult. The problem is being solved in some plants by maintaining nitrogen under slight pressure in all vapor spaces of idle boilers, superheaters and reheaters.

Nitrogen capping is also being used for standby protection of heaters, turbines, piping, pumps, etc. Surge tanks, receiver tanks and similar equipment can even be protected during operation. The essential features are: (1) an uninterrupted supply of nitrogen low in oxygen content; (2) nitrogen pressure held higher than atmospheric pressure; (3) routine checks to make sure there are no lapses in this control.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information on how the Hall System can help you solve *your* water problems, write, wire or call address below.

Water is your industry's most important raw material. Use it wisely.

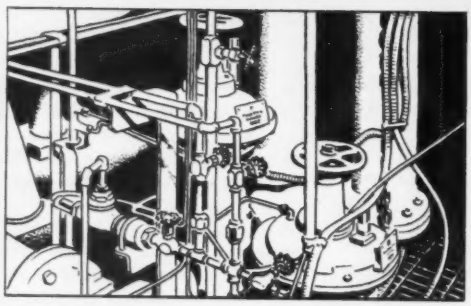
HALL LABORATORIES

DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY; HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

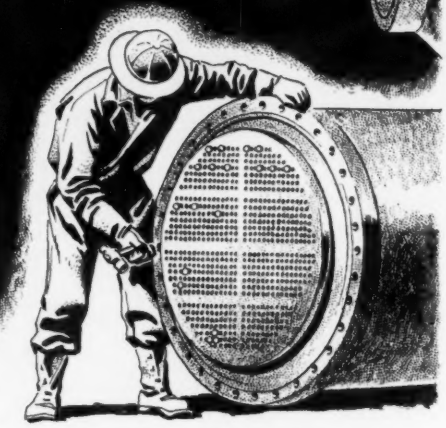
Where metal costs less than plain water

SALTY, SANDY WATER IN CIRCULATION PUMP GLAND SEALS AT A COASTAL POWER PLANT CUT SHAFT SLEEVE LIFE BELOW 2½ YRS. USE OF FRESH WATER IN PACKING GLANDS WOULD HAVE REDUCED ABRASION, CORROSION. BUT THERE WAS A CHEAPER WAY. "S" MONEL* HARD-GRADE NICKEL-COPPER ALLOY SLEEVES, PRODUCED AT INCO'S BAYONNE FOUNDRY, WERE INSTALLED. NOW IN SERVICE 4 YEARS ...NO REPLACEMENTS...THE COST OF "S" MONEL SLEEVES WAS LESS THAN THE ESTIMATED COST OF PROVIDING FRESH WATER FOR LUBRICATION.



"Free" samples...free from impurities at new ion exchange

IT TAKES A MAZE OF SMALL TUBES TO PICK UP SAMPLES OF TREATED WATER, CAUSTIC SODA, AND WATER RINSES FROM AN ANION EXCHANGER. BECAUSE OF A CONSTANT CORROSION PROBLEM CAUSED BY ACID REGENERATION, MONEL ALLOY IS USED FOR THE TUBES, FITTINGS, AND FIXTURES THROUGHOUT THE SAMPLING SYSTEM OF AN EASTERN POWER PLANT'S NEW ION EXCHANGE SYSTEM.



Alloy Plugs for leaky heat exchanger tubes put an end to galvanic corrosion, too

PLUG'S SHAPE PREVENTS TUBE SHEET DAMAGE, MAKES CERTAIN PLUG IS DRIVEN IN CONCENTRIC WITH TUBE. OF MONEL* NICKEL-COPPER AND INCONEL* NICKEL-CHROMIUM ALLOYS, PLUGS ARE CORROSION-RESISTING AND GALVANICALLY COMPATIBLE WITH HEAT EXCHANGER TUBE MATERIAL.

SLOWED DOWN BY A METAL PROBLEM?

A TALK WITH ENGINEERS FROM INCO'S MECHANICAL ENGINEERING SECTION MAY HELP YOU GET BACK ON SCHEDULE. JUST GET IN TOUCH WITH US AND OUTLINE THE DETAILS. AND FOR A USEFUL RUN-DOWN ON MONEL ALLOY, WRITE DEPARTMENT **PE** FOR 30-PAGE INCO BULLETIN, "ENGINEERING PROPERTIES OF MONEL AND 'R' MONEL ALLOYS."

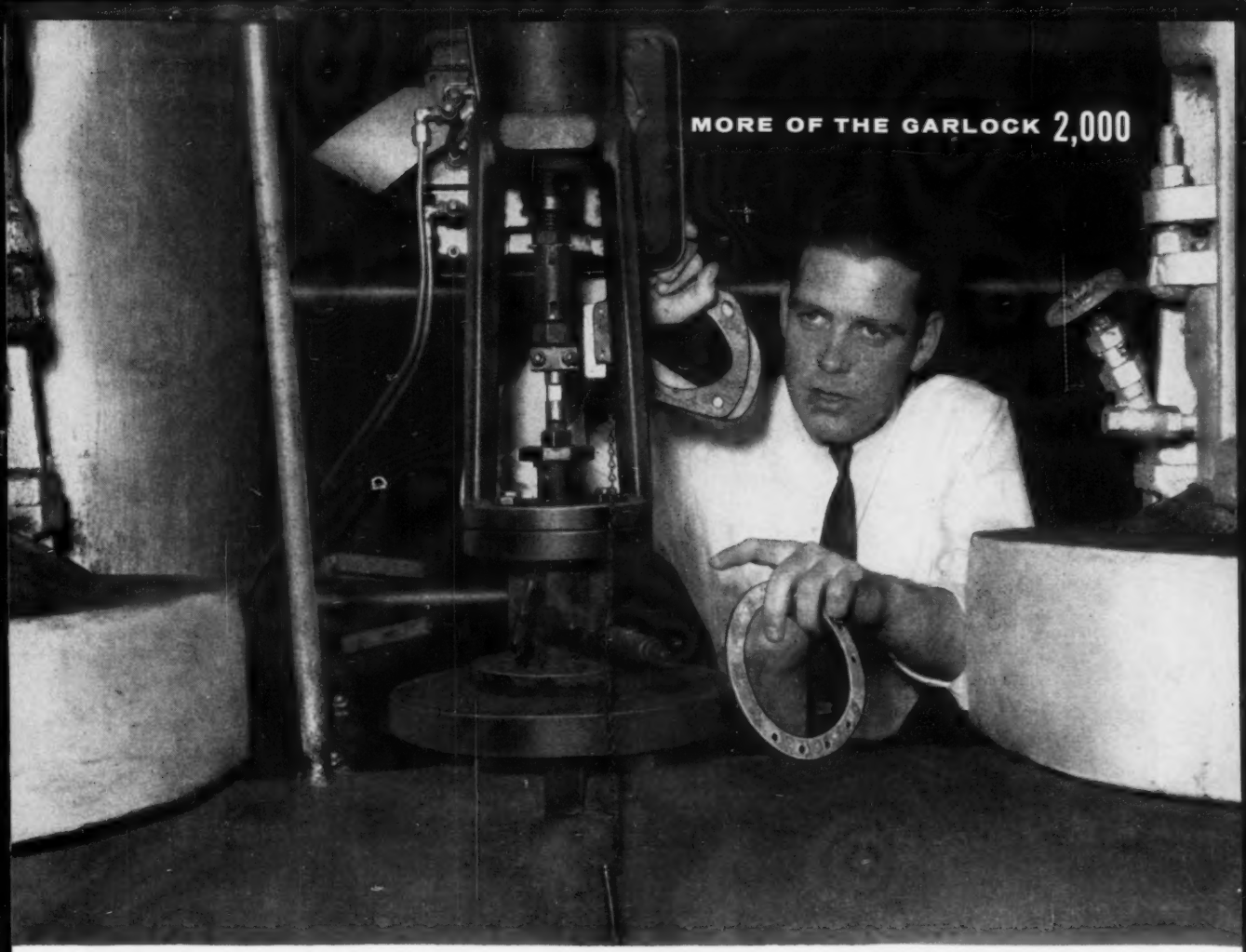
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street
New York 5, N. Y.

INCO TRADE MARK

*Registered trademark

INCO NICKEL ALLOYS

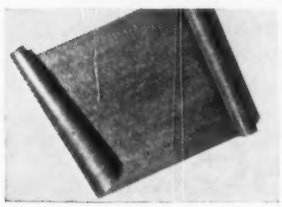
For more facts circle 866 on Reader Service Card p 222



"If you're gasketing against steam or gases to 700°F., try GARLOCK 900"

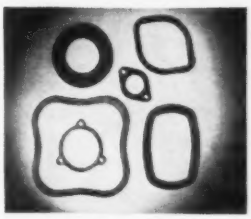
Most engineers agree, that safe positive sealing of pipe flanges and gasketed joints on systems handling steam, gas, or air to 700° F. is best accomplished with a gasket material such as Garlock 900 which is resistant to plastic flow, but is compressible enough to compensate for surface irregularities. Garlock 900 is made from long fiber Canadian asbestos and a special rubber compound bonded under pressure and vulcanized into a homogeneous structure . . . compressible, yet resistant to plastic flow.

"...for hot oils use GARLOCK 7021"



Sealing against hot oils to 700° F. on pipe lines, internal combustion engines, compressors, or other high temperature applications calls for a strong dense gasketing such as Garlock 7021 . . . oil resistant, compressible, yet unusually resistant to plastic flow under heavy bolt loads.

"...for solvents to 300°F.—GARLOCK 7228"



This Compressed Asbestos and Neoprene Gasketing for gasketed joints and pumps, provides the desired compressibility necessary for safe gasketing on systems handling solvents or oils . . . without plastic flow under heavy bolt loads.

These high temperature gaskets are still another part of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. The only complete line. That's why you get unbiased recommendations from your Garlock representative. Call him or write for Gasket Folder AD 162.

THE GARLOCK PACKING COMPANY, Palmyra, N.Y.

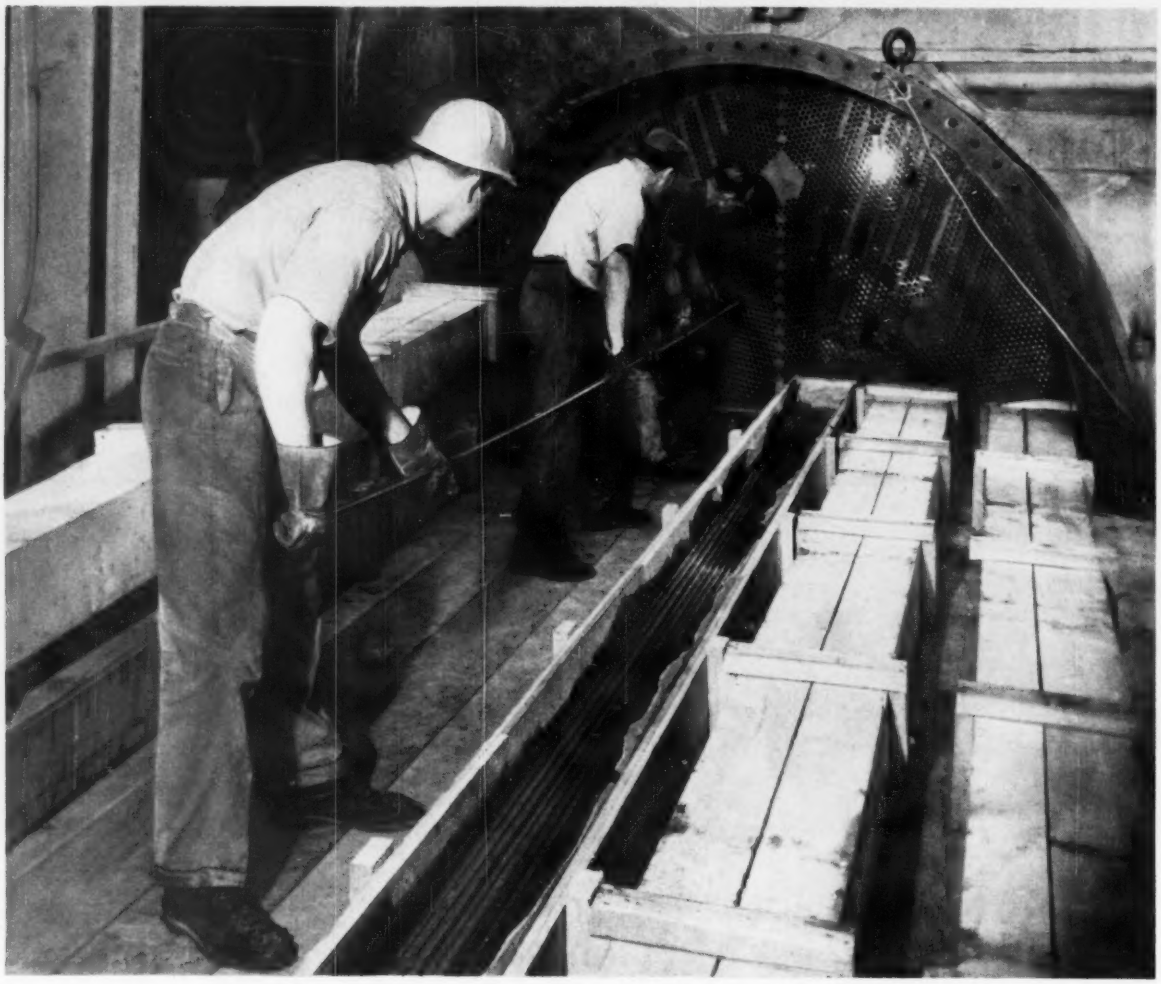
For prompt service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

For more facts circle 867 on Reader Service Card p 222

TUBING OPERATION for divided water box, two-pass condenser. Complete unit has 95,000 sq. ft. condensing surface, serves 125,000 KW steam turbine-generator operating at 1,800 psi pressure, 1,000° F. steam supplied by 950,000 lbs/hr boiler.



OVER EIGHTY MILES OF CHASE CONDENSER TUBE!

East coast power company tubes condenser serving 125,000 KW generator unit

An east coast power company has recently completed tubing a condenser serving a 125,000 KW steam-turbine generator, using nearly 15,000 arsenical aluminum brass tubes, each 28′3¼″ long, by ⅞″ O.D.

Arsenical aluminum brass has proved itself in hundreds of installations of Chase Condenser Tube. Outstanding resistance to impingement attack makes it particularly suitable for use in tidewater power stations, aboard ship and in some oil field installations as well. Chase makes condenser tube to meet any combination of water type, temperature, speed of flow and corrosion conditions—and is ready to provide technical assistance in meeting specific problems, based on years of experience in manufacture and specification of condenser tube. Bring your needs to your nearest Chase Representative, or write Chase at Waterbury 20, Connecticut.

Chase®
BRASS & COPPER CO.
WATERBURY 20, CONN.
Subsidiary of
Kennecott Copper Corporation

The Nation's Headquarters for Brass, Copper and Stainless Steel
Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L.I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

Molded and Extruded Rubber, Plastic Products

For more facts circle 867 on Reader Service Card p 222

'58 Power Show:

Showcase for the plant designer

When the New York Coliseum opens its doors on December 1 to usher in the 1958 Power Show, ASME will be holding its Annual Meeting about a mile away. Right now there is every indication both will be well attended.

ASME Annual Meeting, using the theme "New frontiers in engineering—key to mankind's progress," runs the gamut from peacetime applications of nuclear fission to new developments in control of the automatic factory. There will be reports by some 400 authors on recent engineering advances in power-plant design, machine design, metals engineering, applied mechanics.

Nuclear-engineering sessions at the Annual Meeting will center about 15 papers dealing with the power of the atom used for mankind's benefit. In addition to new developments in design of "conventional" nuclear generating plants (those powered by the fissioning of uranium), speakers will discuss techniques for deriving power from radioisotopes, non-military use of thermonuclear explosions.

Power-Show planners have a few "firsts" in store. Typical: the heaviest single piece of power apparatus ever viewed at a Show. It is a spherical-head feedwater heater weighing 38,000 lb, standing 8 ft high, 38 ft long. Built by C F Braun & Co, heater is slated for shipment after the show to the Holyoke (Mass.) Water Power Co. Two such heaters will operate at 2700 psi, heating 5-million gal of feedwater daily.

Thermal-liquid heaters will be featured at the Show. Apparently heat exchange has been a particularly fertile inventive area in recent years. And interest in the application of thermal liquids has been on the increase (POWER, Aug 1958, p 99).

Plant instrumentation, with its ever-increasing safeguards against man failure, is another Show item.

Going to the Show?

Then use the following listing of Exhibitors' booth numbers as a preliminary guide

If you're not going...

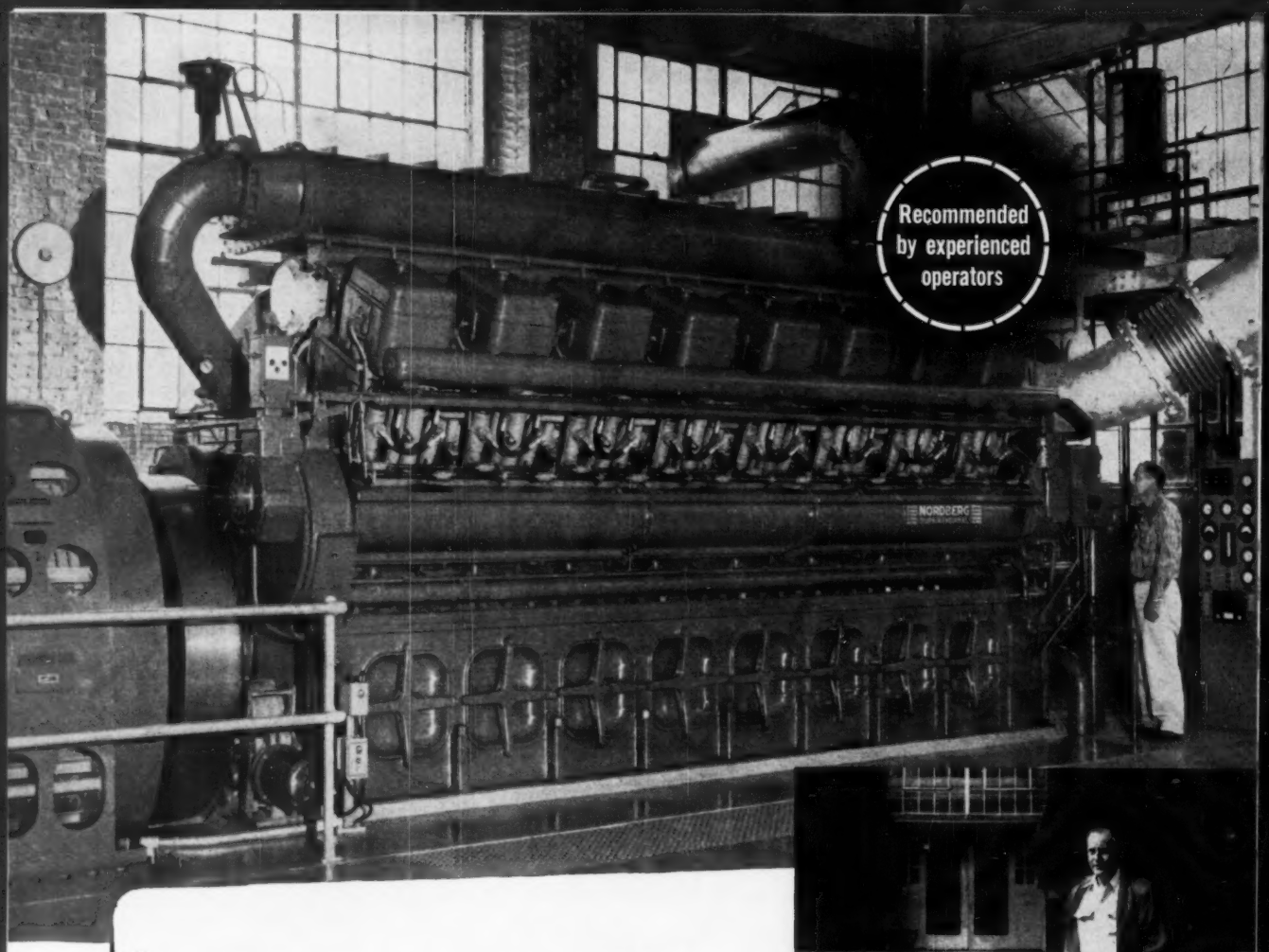
Use Reader Service Card, p 222, to jot down booth numbers of manufacturers on whose products you want more information

Steam generation	*Booth No.*
Allis-Chalmers Mfg Co	531
American-Standard Kewanee Boiler Division	134
American-Standard Ross Heat Exchanger Division	111
Bituminous Coal Institute	175
C F Braun & Co	52
Green Fuel Economizer Co, Inc	100
Harbison-Walker Refractories Co	386
The International Boiler Works Co	175
Fred H Schaub Engineering Co	67
The C E Squires Company	120
Superior Combustion Industries, Inc	586
Titusville Iron Works Company Division Struthers Wells Corp	356
Yuba Consolidated Industries, Inc	595

Nuclear energy	*Booth No.*
Allis-Chalmers Mfg Co	531
Alloy Steel Products Co	668
Flanders Filters, Inc	489
Titusville Iron Works Company Division Struthers Wells Corp	356

Piping, valves and fittings	*Booth No.*
Alloy Steel Products Company	668
Armstrong Machine Works	382
Automatic Switch Company	686
The Babcock & Wilcox Company Tubular Products Div	420
Barnes & Jones, Inc	641
Beemer Engineering Company	409
Black, Sivalls & Bryson, Inc	456
Carpenter and Paterson, Inc	695
Chemiquip Company	619
Chiksan Co, (Food Machinery & Chemical Corp)	68
Crawford Fitting Co	615
Diamond Expansion Bolt Co, Inc	190-E
General Controls Company	644
Golden Anderson Valve Specialty Co	388
Henry Vogt Machine Company	104

(*Continued on page* 221)



"Neodesha has now installed their sixth Nordberg engine ...all are giving a good account of themselves..."

...says Mr. Everett Powell,
Superintendent,
City of Neodesha, Kansas

Mr. Powell writes: "*The City of Neodesha has now installed their sixth Nordberg engine since 1922—all are giving a good account of themselves. Our newest, a 3150 B.H.P. Nordberg V-16 Supairthermal Duafuel unit, has been operating very satisfactory and we expect the same excellent service as recorded by our prior installed 1750 B.H.P. Duafuel unit. Our recent overhaul on this 1750 B.H.P. unit showed that rings and bearings still did not need replacement after 40,000 hours.*"

Here, then, are more reasons why Nordberg engines are recommended by experienced power plant operators . . . more reasons why there are so many *repeat* orders for Nordberg Diesel, Duafuel®, and Spark-Ignition Gas engines. Next time consult Nordberg on your power study . . . builders of a full range of engine sizes from 600 to over 12,000 hp. *NORDBERG MFG. CO., Milwaukee, Wisconsin.*

Installation Data:

1922—Installed 2 Nordberg 550 hp engines in Neodesha plant.

1934—Installed Nordberg 880 hp engine.

1946—Installed Nordberg 1620 hp engine.

1952—Installed Nordberg 1750 hp engine.

1956—Installed sixth Nordberg engine . . . a 16-cylinder V-type Supairthermal® Duafuel engine rated 3150 bhp, 2250 kw.

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

© 1957 Nordberg Mfg. Co.

P757

For more facts circle 869 on Reader Service Card p 222

Piping, valves and fittings	*Booth No.*
Hydraulics Inc	640
Jerguson Gage & Valve Co	631
Kieley & Mueller, Inc	469
C H Leibfried Mfg Company	676
Lewin-Mathes Co Div of Cerro de Pasco Corp	398
McDonnell & Miller, Inc	560
National Tube Div, U.S. Steel	636
W H Nicholson Company	410
Penberthy Manufacturing Company Div of Buffalo-Eclipse Corp	445
Valcor Engineering Corp	626
Velan Steam Specialties	49
J H H Voss Co, Inc	613
Yarnall-Waring Company	532
Yuba Consolidated Industries, Inc	595
G S Ziegler & Company	671

Heating and air conditioning	*Booth No.*
American Hydrotherm Corp	75
American-Standard Kewanee Boiler Division	134
Armstrong Machine Works	382
Cleaver-Brooks Co	541
Diamond Expansion Bolt Co, Inc	190-E
Flanders Filters Inc	489
General Controls Company	644
Green Fuel Economizer Co, Inc	100
International Boiler Works Co	175
The Johnson Corp	374
McDonnell & Miller, Inc	560
W H Nicholson Company	410
Owens-Corning Fiberglas Corp	415
The Philip Carey Mfg Company	55
The C E Squires Co	120
Titusville Iron Works Company Division Struthers Wells Corp	356
Velan Steam Specialties	49
Yuba Consolidated Industries, Inc	595
G S Ziegler & Company	671

Water treatment	*Booth No.*
Allis-Chalmers Mfg Co	531
American Meter Co, Pump Div	150
Graver Water Conditioning Co	492
Hungerford & Terry, Inc	559
Illinois Water Treatment Co	361
McDonnell & Miller, Inc	560
Power Chemical Company	666
Fred H Schaub Engineering Co	67

Mechanical power transmission	*Booth No.*
Allis-Chalmers Mfg Co	531
Boston Gear Works	51
Poole Foundry & Machine Co	44
The C E Squires Co	120

Electrical generation transformation, conversion	*Booth No.*
Allis-Chalmers Mfg Co	531
Katolight Corporation	372
D W Onan & Sons Inc	614
Rapid Electric Co	621
Troy Engine & Machine Company	594

Electrical distribution	*Booth No.*
Allis-Chalmers Mfg Co	531
Automatic Switch Company	686
Continental Electric Equipment Co	645
The Globe Company	66
Zenith Electric Company	568

Electrical applications	*Booth No.*
Allis-Chalmers Mfg Co	531
The Louis Allis Company	134
Furnas Electric	196
McDonnell & Miller, Inc	560
Zenith Electric Company	568

Pumps and compressors	*Booth No.*
Allis-Chalmers Mfg Co	531
American Meter Co, Pump Div	150
Lapp Insulator Co, Inc	365
McDonnell & Miller, Inc	560
Penberthy Manufacturing Co Div of Buffalo-Eclipse Corp	445

More Power Show exhibitors listed on page 224 ►

PLEASE TYPE OR PRINT

Your Name .....

Position .....

Company .....

Co. Address .....

City and State ..... Oct 1958

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How to get the most out of this issue

Either of the no-postage Reader Service Cards below will bring you FREE valuable additional information on any item listed in the Equipment & Literature Roundup; on any advertised product appearing in this issue; on many of the products that will be displayed at the coming Power Show. Here's all you need do to get this information:

Tear out the card

Start by tearing out one of the Reader Service Cards shown below. Keep it handy on your desk as you read through the issue from cover to cover.

Study the Equipment & Literature Roundup

Circle key numbers on Card corresponding to items in Equipment & Literature Roundup on which you want more info. This section starts on p 227.

Circle key numbers below for FREE information on . . .

NEW PRODUCTS reviewed, starting on p 227

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59
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NEW LITERATURE listed, starting on p 227

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696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724
725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754
755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775

ADVERTISED PRODUCTS appearing throughout the issue

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806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834
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POWER SHOW product information. Write in Booth numbers (see p 219)

____ ____

____ ____

NOTE: Fill in your name and business address on other side of card →

Read the advertisements

As you read the advertisements throughout the issue, circle key number on the Reader Service Card corresponding to number listed below each ad.

Scan the Power Show listing

Many exhibitors in the upcoming Power Show (Dec 1-5 in N. Y. Coliseum) are listed with their Booth numbers starting on p 219. If you don't plan to attend the Show, write in the Booth numbers of manufacturers in whose products you are interested. Makers are listed in this issue according to the products they are planning to display at the Show.

Print your name and company

Complete the Card by filling in your name, company, company address on the front of Card. Then drop in the mail; no postage stamp is necessary.

Have patience

It will probably be several weeks before you receive the information you request. After the Reader Service Card is received by POWER, your name along with others requesting similar data is sent to the individual manufacturers. The information you seek will be mailed directly to you by manufacturer.

Circle key numbers below for FREE information on . . .

NEW PRODUCTS reviewed, starting on p 227

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
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ADVERTISED PRODUCTS appearing throughout the issue

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POWER SHOW product information. Write in Booth numbers (see p 219)

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NOTE: Fill in your name and business address on other side of card →

Pumps and compressors	*Booth No.*
Fred H Schaub Engineering Co	67
United States Steel Corp	626
Viking Pump Company	687
J H H Voss Co, Inc	613
Instrumentation	*Booth No.*
Air Conditioning Equipment Corp	424
Bailey Meter Company	515
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Burling Instrument Co	566
Electronics Corp of America Combustion Control Div	157
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McDonnell & Miller, Inc.	560
Samuel Moore & Co Dekoron Products Div	565
Penberthy Manufacturing Co Div of Buffalo-Eclipse Corp	445
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Spence Engineering Co, Inc	206
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Chemiquip Company	619
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Flanders Filters Inc	489
Furnas Electric	196
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The Globe Company	66
The Gustav Wiedeke Co	574
Harbison-Walker Refractories Co	386
J Heller & Sons	216
International Research & Development Corp	70
The Johnson Corporation	374
Owens-Corning Fiberglas Corp	415
The Philip Carey Mfg Company	55
Power Chemical Company	666
Raybestos-Manhattan, Inc.	163
The Ridge Tool Company	184
The Spencer Turbine Company	682
Sumco Engineering Company	681
The Toledo Pipe Threading Machine Co	194
Other services or equipment	*Booth No.*
Norman Bragar Co, Inc	690
Chemiquip Company	619
Cobra Metal Hose Div D K Mfg Co	625
Gulton Industries, Inc	414
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Malan Construction Corp	674
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Note: *The foregoing listing of Exhibitors is, of necessity, preliminary. For a complete list see the* Guide & Directory *available at the Show*

PLEASE TYPE OR PRINT

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Position .....

Company .....

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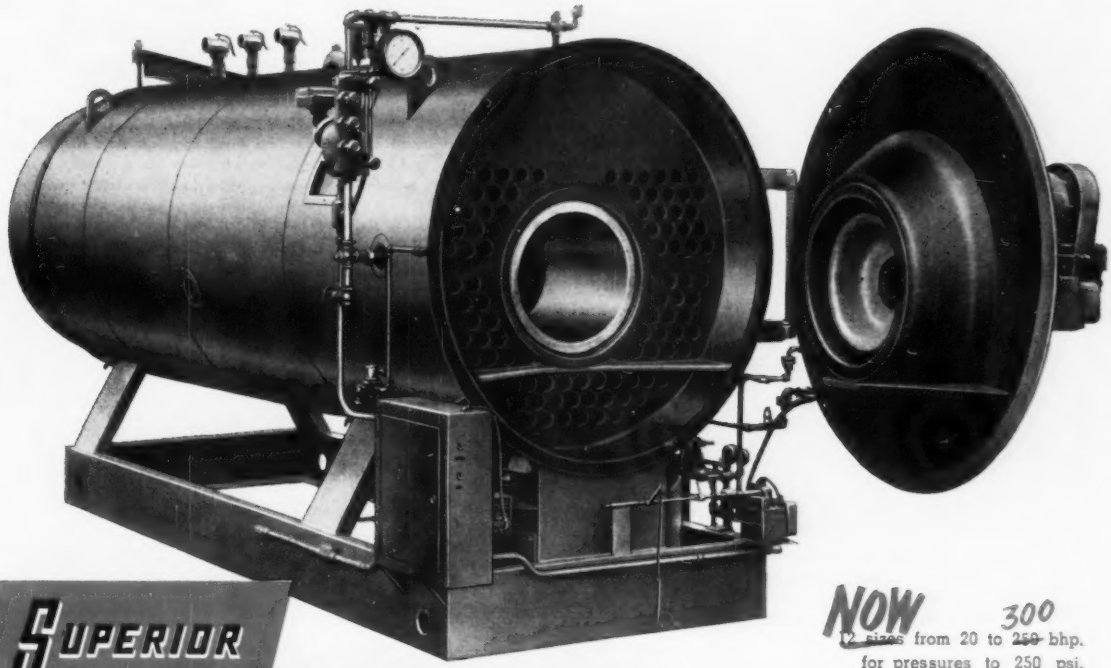

SUPERIOR "COMPACT"

NOW ~~12 sizes~~ 300 from 20 to ~~250~~ bhp. for pressures to 250 psi. or for hot water. Fully automatic operation firing oil or gas or both. Before you buy or specify any packaged boiler, get the details in Bulletin 1000-C

all the big boiler features you want combined with accessibility and easy maintenance

With a full 5 sq. ft. of heating surface per bhp., 4-pass, down-draft design, and built-in induced draft, the Superior COMPACT is a highly efficient and dependable package. Its efficiency, guaranteed by factory-fire-test of every unit, insures years of economical performance; for the Superior COMPACT is planned for the easy maintenance which sustains high efficiency.

Front doors are hinged, and rear doors hinged or davited to simplify inspection and cleaning. But note that no belts or mechanical components are located inside the front door where they would be subject to the heat of the fire. All units firing #4, #5 and #6 oil are equipped with dependable Superior Rotary Burners. High in the shell, and protected by the tubes of the fourth pass, the furnace is away from the "danger zone" eliminating the possibility of bagging or blistering.

Specialists in PACKAGED BOILERS . . . exclusively

SUPERIOR COMBUSTION INDUSTRIES INC.
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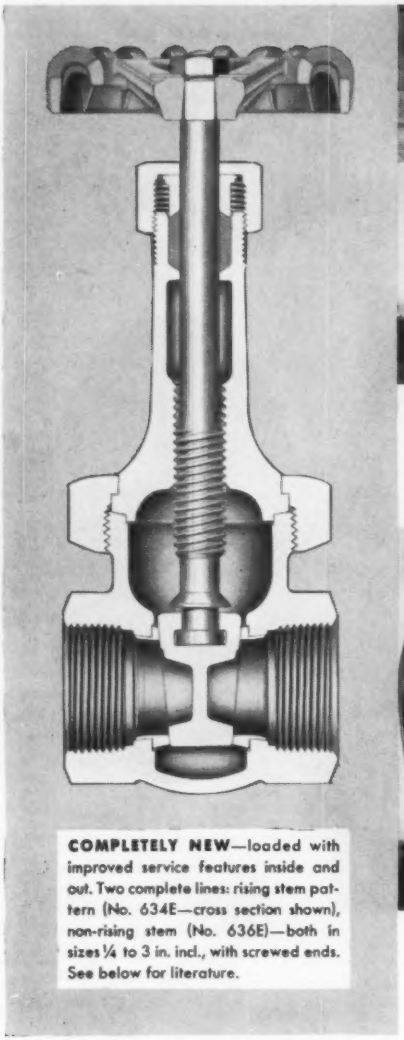
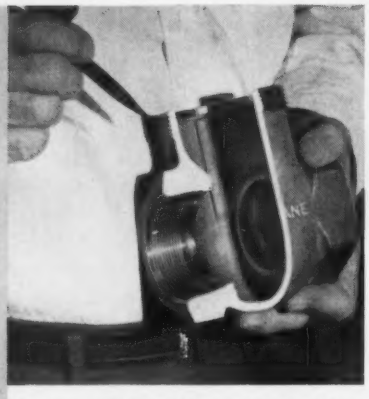
SUPERIOR PACKAGED BOILERS

For more facts circle 871 on Reader Service Card p 222

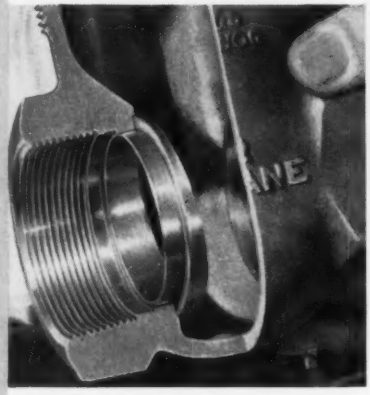


COMPLETELY NEW—loaded with improved service features inside and out. Two complete lines: rising stem pattern (No. 634E—cross section shown), non-rising stem (No. 636E)—both in sizes ¼ to 3 in. incl., with screwed ends. See below for literature.



NEW CYLINDRICAL BODY SHAPE—a proven design on high-pressure steel valves—increases strength without added bulk, distributes pressure load uniformly, resists distortion and leakage at seats.

NEW, STRONGER HEX ENDS, better integrated with body, eliminate sharp contours, give entire valve more rigidity under line strains. Wider hex faces allow firmer wrench grip for easier installation. Marring less likely.



NEW, EXPANDED-TYPE BODY RINGS insure long, tight-seating service life. They're rolled in, can't work loose. Shoulder at bottom of end threads restrains excessive entry of pipe against possible seat damage.

NEW EXELLOY, 12% chromium steel body rings give a hard bearing surface, highly resistant to wear, indentation, scoring and foreign matter damage. Easily replaced bronze disc takes the brunt of normal wear.

New design for tough service...easy maintenance

300-Pound Wedge Disc Bronze Gate Valves

Rising Stem and Non-Rising Stem Patterns

A new body shape that distributes greater strength uniformly against internal stresses and external strains . . . better integrated hex ends, huskier and wider, that add to body rigidity and give a firmer wrench grip . . . new rolled-in, high wear-resisting alloy body rings that don't work loose . . . easily renewed wedge disc—these are typical important features of new Crane bronze gate valves.

On your toughest services, these valves assure ultimate durability . . . new ease of application . . . low-cost repairability. And they're priced no higher than ordinary 300-pound integral seat bronze valves.

Easy to Repair—The Disc Takes the Wear

After long, hard service the hard Exelloy (12% chromium) body rings show no appreciable wear. Normal seating wear is taken by the bronze disc. When needed, a new disc, easily slipped onto stem, provides a practically new, tight-seating valve.

Circular Gives The Facts

For complete technical data on both rising stem and non-rising stem patterns . . . size listing, etc., get Circular AD-2340 from your Crane Representative, or by writing to address below.

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EQUIPMENT and LITERATURE Roundup

A 36-page survey of the latest power-service equipment and literature

Once a power-service design has firmed up, the next big job is the selection of specific equipment to do the job. Intelligent equipment selection calls for up-to-the-minute knowledge of the latest product designs. Here's where we can be of immediate help.

For months we have combed the seemingly endless number of equipment designs and product bulletins that have come into the power market place during the past year. And we asked every equipment maker in the power field to propose what *he* considered his most significant equipment advances over this span. We then carefully sifted the wealth of information on tap: results are shown on the pages that follow. Let it serve as your equipment and literature guide to successfully plan '59.

By A P SOMMER
Assistant Editor

Steam generation — 228
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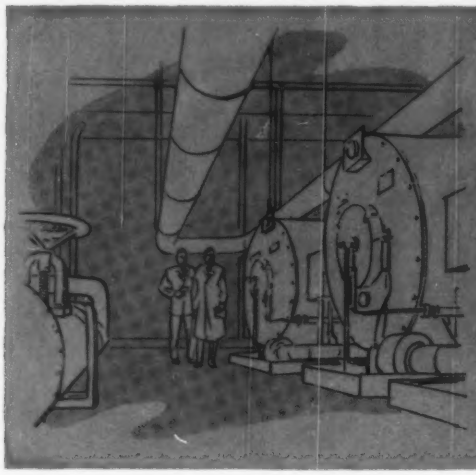


Steam-generating units and associated equipment listed below are typical of "last-word" designs offered to users seeking greater returns in power-plant economy.

Packaged boilers will take an even-greater share of capacity supplied by units under 100,000 lb steam per hr. The "package" concept is being applied more extensively to shop-assembled and field-erected boilers in form of prefabrication and subassemblies. All of which means better products, greater savings for the user.

Design philosophy in firing, fuel- and ash-handling, dust-collection and control equipment, too, is geared to the user's natural desire for ever-greater profits.

Assistant Editor

Recent equipment designs: Circle key numbers on Reader Service Card, page 222, to get further information

1 **Oil and/or gas fired,** pressurized-furnace steam generator is designed for power, process or heating loads reaching 400,000 lb steam per hr. Unit offers prefabricated furnace construction with welded "membrane wall." It's available for steam pressures to 1150 psi, superheated steam temperatures to 900 F. Space needed is cut by integral combustion air duct at top of unit that eliminates extra ductwork. Superheater can be drained of water after a shutdown, providing both easy storage and prompt startup. Burners are centralized for quick observation and adjustment.—The Babcock & Wilcox Company

2 **Compactly designed steam, heating boiler** needs less than one-third of floor space usually required. Test units are said to have substantially cut fuel operating cost and maintenance. Boiler's vertical-tube arrangement allows rapid water circulation and high heat transfer, resulting in 80% thermal efficiency.—Hercules Power Equipment Company

3 **Low first cost, high fuel economy** are claimed features of packaged automatic boiler for smaller industrial, commercial, institutional uses. High-pressure and low-pressure models (15 psi) handle both steam or hot-water service. Units are equipped with mechanical pressure-atomizing oil burner or partial premixing gas burners for burning light oil or any commercial gas fuel.—Orr & Sembower, Inc

4 **No expensive chimney needed** with this packaged boiler since vent removes combustion gases from boiler room. Available through 60 hp or 2070 lb steam per hr, unit can be oil or gas fired or furnished with combination burner.—Cleaver-Brooks Company

5 **Automatic packaged-boiler line** is reported to (1) reduce needed air pressure (2) require smaller blower motor and (3) consume less electricity. Burner head fires either natural or mixed gas. Units from 30 to 125 hp supply high- or low-pressure steam or hot water. Overall thermal efficiency is 80%.—York-Shipley Inc

6 **Large packaged watertube boilers** handle steaming rates of 10,000 to 45,000 lb per hr at up to 250 psi. Superheat is available in larger ratings. Units are oil- or gas-fired with electric or pneumatic automatic controls. Large upper and lower drums, plus elimination of headers provide free water circulation. No special foundations needed.—Dominion Bridge Co, Ltd

7 **Completely automatic, fast-steaming** watertube boilers need no chimney for forced draft—merely an outlet for gases. Sizes ranging from 20 through 150 hp can be furnished to deliver l-p steam at 0 to 15 psi, or in a h-p line supplying 5 to 150 psi. The 150-hp model occupies 41.3 sq ft of floor space, is 7 ft 3 in. high. Only 2 ft of surrounding space is necessary for servicing. No special flooring is needed since the 7000-lb weight is distributed at less than 175 lb per sq ft. —Vapor Heating Corporation

8 **Forced-draft burner** on these fully automatic oil/gas fired boilers eliminates need for elaborate controls, a stack or an i-d fan. Watertube construction coupled with multi-pass design assures rapid steam or hot-water generation and a guaranteed 81% themal efficiency.—The International Boiler Works Company

9 **New 3-pass Scotch-marine boiler** has a water-cooled rear combustion chamber that eliminates need for refractory in this area. Complete wetback construction means hot gases are in constant contact with water-cooled steel walls. Unit is made in l-p S3H series and h-p S3P series in sizes from 1725 to 31,050 lb steam per hr. (Latter is reported to be the largest firetube packaged boiler manufactured.) Boiler efficiency (both gas and oil fired) tops 80%.—Titusville Iron Works

10 **Steam-atomizing packaged firing units** for oil and/or gas fuels are fully automatic, offer these features: low fire start, electric-gas ignition, modulation fire control, damper sequence control, f-d combustion air, electronic combustion safety supervision.—National Airoil Burner Co, Inc

11 **Installation of packaged-boiler gage unit** needs but two field welds to drum connections. Gage is shipped completely welded, shop tested to full boiler-design steam pressure.—Diamond Power Specialty Corp

12 **Automatic oil heater generates to 500 F,** operates at below 15 psi. All-electric control system is mounted in centralized, weatherproofed control box. Heaters burn light or heavy oil, gas or a combination. Five models have outputs of 1,050,000 to 3,650,000 Btu per hr.—Bros Incorporated

13 **Blowdown and sampling system** combines, in a sleek console, the volume-control valves, heat exchanger and flash tank of the usual continuous-blowdown system, with all interconnecting piping, plus five special features: (1) automatic aftercooling at the drain connection (2) automatic timed pressure flush to maintain high recovery efficiency (3) complete instrumentation (4) automatic sample cooling (5) matching cabinet sink for water tests. Manufacturer points out that packaged design saves engineering man-hours, field-erection time and operating labor; yields compact unit that fits in with smart boiler-room layout. Available in either 250- or 600-psi designs, to handle two, three or four boilers in a single console with total capacities to 6000 lb per hr of blowdown.—Fred H Schaub Engineering Company

14 **Dust collector using 24-in. tubes** can be installed economically where collection efficiencies below 85% are sufficient. Unit collects abrasive and high-moisture-content materials.—Research Cottrell, Inc

15 **Single-tip retractable burner nozzle** that simplifies cleaning is big attraction of 4-pass f-d boiler line. Units have 5 sq ft of heating surface per boiler hp. Vibrationless impeller mounted directly on blower motor shaft gives quiet operation since sound is muffled within front head.—Cleaver-Brooks Company

16 **Factory-assembled f-d burner** forms an automatic packaged boiler-burner unit for high- or low-pressure steam or hot-water heating, with maximum rated capacities from 80 to 750 developed output hp. Burner specs may be selected to burn No. 2 to 6 fuel oil, h-p or l-p gas, or a combination.—Ray Oil Burner Co

17 **Largest reversible hammermills** ever used in cyclone-furnace installations have been developed to meet trend toward ever-larger capacity. Units, designed to furnish 600 tons per hr of 95% minus four mesh coal from 2-in. feed, are equipped with 1250-hp 720-rpm wound-rotor motors, with Falk flexible couplings to give a crusher speed of 720 rpm. Two units reportedly furnish 1200 tons per hr—a job that formerly required at least four crushers. In terms of plant design this means a much more simple layout.—Pennsylvania Crusher Div, Bath Iron Works Corporation

18 **Variable-speed feeder** provides greater capacity and automatic control over complete feeding range. Designed around the overthrow principle, unit feeds fuel continuously from stoker hopper to distributing rotors by means of a chain-conveyor mechanism. Automatic control range is from maximum feed to zero feed.—Detroit Stoker Company

19 **Finger-tip control of every step** in the soot-blowing sequence is reported feature of system. Operator can preselect any number of blowers to be operated through automatic sequence or individually. System also permits (1) reversing any retractable blower at any point in its cycle (2) switching from automatic-sequence to single-unit operation. Three models are offered.—Copes-Vulcan Div, Blaw-Knox Company

Free steam-generation bulletins: Circle key numbers on Reader Service Card, page 222, to get your copies

371 **Bent-tube boilers** are covered in 22-p bulletin VF-VS 2. Diagrams show various installation from 26,400 to 675,000 lb steam per hr. Henry Vogt Machine Company

372 **Two-drum boilers** are subject of 12-p catalog SB-58. Covers design, uses. Erie City Iron Works

373 **Packaged generators** for forced-circulation hot-water systems are detailed in 6-p spec sheet. Cyclotherm Div, National-U.S. Radiator Corporation

374 **Automatic boilers** for steam or hot-water heating and hot-water service are subject of 4-p bulletin 1243. Lists packaged units in 15 to 25-hp range. Orr & Sembower, Inc

375 **Packaged boilers,** oil- and gas-fired, are subject of 16-p catalog. Details 35- to 500-hp units. Dominion Bridge Co, Ltd

376 **Baffleless,** pressurized 2-drum water-tube packaged boiler is described in 12-p catalog SB-59. Erie City Iron Works

377 **Bituminous** coal-fired watertube packaged steam generators to 200 psig are topic of 10-p bulletin 1100. International Boiler Works

378 **Industrial burner** catalog lists gas, oil, combination units from 4000 to 60,000 lb steam per hr. Coen Co

379 **Firetube** 3-pass steam generator is described in catalog 56A. Packaged unit has gas vent in rear. Erie City Iron Works

380 **Waterback** 3-pass packaged boiler is subject of 8-p bulletin 509B. Contains data on firing equipment, accessories, fuels. Johnston Brothers, Inc

381 **Self-contained boiler** for heating and processing steam or hot water are detailed in 8-p bulletin AD-162. Cleaver-Brooks Co

382 **Selection survey form** lists boilers suitable for different uses. Covers electrical supply, fuels, boiler-room size, feedwater. Orr & Sembower, Inc

383 **Dust-collection equipment** is subject of bulletin A-9157. Covers line of wet and dry collectors, auxiliaries. The Ducon Co, Inc

384 **Dust-collection system** that handles 5 tons per hr is described in 8-p bulletin. Covers first-, second-stage units. Buell Engineering Co, Inc

385 **Wet dust collector** is discussed in 12-p bulletin 581. Unit works by centrifugal and impingement action. Dust Suppression & Engineering Co

386 **Dust-collector maintenance,** water treatment for wet type units is covered in 2-p bulletin WDC. The North American Mogul Products Co

387 **Smokestacks** made of Permaglas are described in 8-p bulletin SS-202A. A O Smith Corporation

388 **Design criteria** for stacks and breechings is subject of 23-p report. Covers sizing, connections, etc. Orr & Sembower, Inc

389 **Refractory brick** is discussed in 24-p booklet that contains conversion charts for h-t applications, graphs, tables, technical data. Norton Co

390 **Automatic soot-blowing** control systems are described in 16-p bulletin 1029. Copes-Vulcan Div, Blaw-Knox Co

391 **Wet inertial type** dust collector with collection efficiencies of 95% of all dust 5 microns in size, 80% of dusts in 1 micron range is detailed in illustrated 12-p bulle-

tin J-616. Gives complete specs. Joy Manufacturing Company

392 **Feedwater heaters** are discussed in 16-p bulletin 300. Outlines uses, design problems. The Griscom-Russell Co

393 **Aerostatic** dust collector is described in 6-p bulletin MSP-124A. Hagan Chemicals & Controls, Inc

394 **Seam protectors** for hrt boilers are discussed in 2-p bulletin. Units form close-fitting joints over caulked or patched seams. National Boiler Protector Co

395 **Watertube** packaged boiler for oil, gas, coal is subject of 20-p catalog VLP. Includes diagrams, tables. Erie City Iron Works

396 **Oil heaters** are treated in 4-p folder showing internal construction of coil designs. Bros Inc

397 **Cyclone** dust collectors are shown in 8-p bulletin C-958. Details design, structural features. The Ducon Co, Inc

398 **Steam-heating coils** are discussed in 26-p booklet B-1710. Includes diagrams, selection tables. Sturtevant Div, Westinghouse Electric Corporation

399 **Magnetic O_2 system** for steam power plants is described in 4-p data sheet 463-60. Leeds & Northrup Co

400 **Fuel-oil conditioner** is subject of 4-p bulletin. Automatic unit pumps oil from main storage tank, circulates it at combustion temperature. Power Mfg Co

401 **Feedwater heaters** are subject of 4-p bulletin 150. Includes photos, diagrams. Hoppes Mfg Company

402 **Safety controls** for 1-p steam boilers are covered in 24-p booklet. Contains detailed diagrams. McDonnell & Miller, Inc

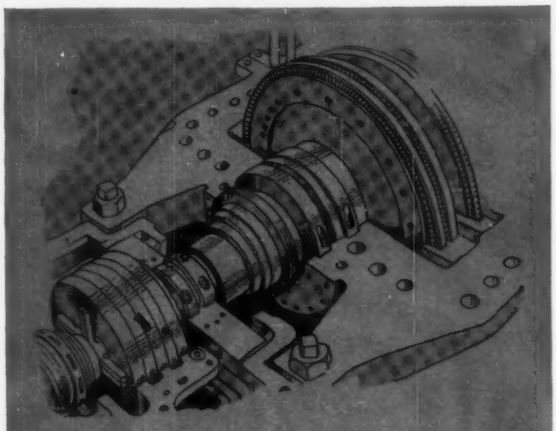
403 **Refractory** for steel mills and foundries is described in 4-p bulletin 872. Use of plastic firebrick is included. Denver Fire Clay Co

404 **Boiler control** systems for large utility power stations are described in 12-p bulletin 1038. Combustion, fuel cutback, feedwater are discussed. Copes-Vulcan Div, Blaw-Knox Co

405 **Data card TDC-157** is for welded carbon-steel boiler tubes. Lists max allowable working pressure by tube sizes. The Babcock & Wilcox Company

406 **Index** to ASME *Boiler and pressure vessel code* is condensed in 4-p folder. Design data is indexed. Downingtown Iron Works Inc

407 **Ash-handling,** dust-control, air-classifying equipment is discussed in 24-p illustrated booklet. Fluor Products Company



While supercritical pressures and temperatures have made technical headlines, solid progress appears in the more familiar machinery. Designers continue to seek better materials and methods in their fight to hold down power costs. Today's energy needs come from tiny 1-hp packages to gargantuan half-million-kw units. Each has its vital duty and needs painstaking attention to achieve maximum reliability and economy. Below is a typical, but by no means complete, list of what equipment builders offer today for a more busy and more prosperous '59.

B. G. A. Skrotzki
Associate Editor

New equipment designs: Circle key numbers on Reader Service Card, page 222, to get complete product story

20 **Quick-starting 3250-hp gas turbine** runs at 8500 rpm; any output speed can be obtained through gearing. Operating speed reportedly is reached in less than three minutes. At full load, exhaust flow is about 191,000 lb per hr at 775 F. Unit is 21-ft long, 6-ft wide, 4½-ft high, weighs 14,000 lb, and is designed as a mechanical drive for pumps, compressors or generators.—Westinghouse Electric Corporation

21 **Turbocharged free-piston engines** yield pneumatic power. Wide shaft-hp range is made possible by two types of units: single stage DL design and 2-stage turbocharged FP-165 model. DL design uses patented movable compressor head to yield a 500-shaft-hp output; several units can be combined in multiples with one turbine to reach a peak of many thousand shaft hp when turbocharged. FP-165 produces 250 shaft hp with turbocharging, 125 shaft hp without. Units are said to combine power-to-weight ratio and torque characteristics of open-cycle gas turbine with thermal efficiency of a diesel.—Baldwin-Lima-Hamilton Corp

22 **Low-cost peaking is advantage** of new 20,500-kw gas turbine. Available for gas or distillate oil fuels, unit is equipped with high-flow compressor, is suitable for 1600-F firing temperature. Maker views unit as answer to electric utilities' problem of supplying power at low cost for a short period when system load increases sharply.—General Electric Company

23 **Field experience shows turbocooler** can up hp output of gas and gas-diesel engines 23%, reduce fuel consumption 5%, maker states. Unit is a turbine-driven centrifugal compressor equipped with an aftercooler. It can be used with either new or existing engine equipment.—The Cooper-Bessemer Corporation

24 **High power-to-weight ratio diesels,** operating at a constant speed of 3000 rpm, can be harnessed to small industrial equipment. Single- to 4-cyl models weigh 243 to 503 lb, develop from 6.25 to 25 hp. Single-cyl design has tunnel-bore crankcase and flywheel cooling fan. Larger models come with underslung crankcases, high-level axial-flow fans.—Petters Ltd.

25 **Supercharged diesel boasts a 50% power gain,** fuel savings of 5 to 10%. It's reported to be the smallest, lightest unit in its hp range. Both 6- and 12-cyl models are available with turbocharging. Weight of 6-cyl basic engine is 24,900 lb and 12-cyl unit weighs 46,200 lb—gains of only 2000 and 4000 lb over nonsupercharged models. Top rating for the 12-cyl diesel is 3600 hp at 900 rpm.—Fairbanks, Morse & Company

26 **Engine provides 450 hp at 1100 rpm** for pumping units, electric power generation, other heavy industrial work. Turbocharger develops extra hp. LRT-6 industrial unit is 99 5/16-in. long, 39 5/16-in. wide, 56¾-in. high, weighs 7690 lb.—Cummins Engine Co

27 **Analyzer takes a cost-cutting look** at the inner mechanical functionings of industrial engines, without expensive shutdowns. The hand-portable multipurpose equipment pictorially displays info on ignition, vibration and pressure. It uses a highly specialized oscilloscope to probe inner recesses of engines, presents functional info on 5-in. cathode-ray screen. Advantages reported are simplicity of operation and easy interpretation. Connections are made without stopping the engine.—Sperry Gyroscope Company

28 **Indicator-analyzer measures directly** all i-c engine pressures, vibrations and ignition voltages. Combined electronic pressure indicator and engine analyzer utilizes electrostatic principles to make precision dynamic measurements. System is built around a pressure gage that provides visual display of engine functions on a standard oscilloscope screen.—Kistler Instrument Corporation

29 **Fuel-injection unit** incorporating two convex seat check valves and new injector spring seat is reported to eliminate after-dribble or leakage. Simple self-contained unit acts as both pump and nozzle, does away with long h-p fuel lines.—Murphy Diesel Co

Free prime-mover bulletins:

To get your copies, circle key numbers on Reader Service Card, page 222

408 **Combustion** gas turbines in 4750 to 21,800-kw range are discussed in 24-p booklet GED-3603. Includes cross sections, cutaways, installation photos. General Electric Company

409 **Gas engines,** 4-cycle V-angle, in 220- to 1760-hp range are described in bulletins 10051-52-53. Includes specs, diagrams. Ingersoll-Rand Company

410 **Steam turbines,** 2000 to 16,500 kw, are covered in 40-p bulletin O3B7654A. Gives data on condensing, noncondensing, condensing automatic-extraction, and noncondensing automatic extraction units. Includes complete specs, 4-color diagrams. Allis-Chalmers Manufacturing Company

411 **Four-cycle** in-line engines are subject of 16-p bulletin 257. Separate data sheets give ratings, dimensions. Nordberg Manufacturing Company

412 **Hydraulic turbines** are described in 48-p bulletin O2B7301A. Allis-Chalmers Manufacturing Co

413 **Diesel engines,** 88- and 131-hp units, are detailed and illustrated in 16-p catalog BU-413. Allis-Chalmers Manufacturing Co

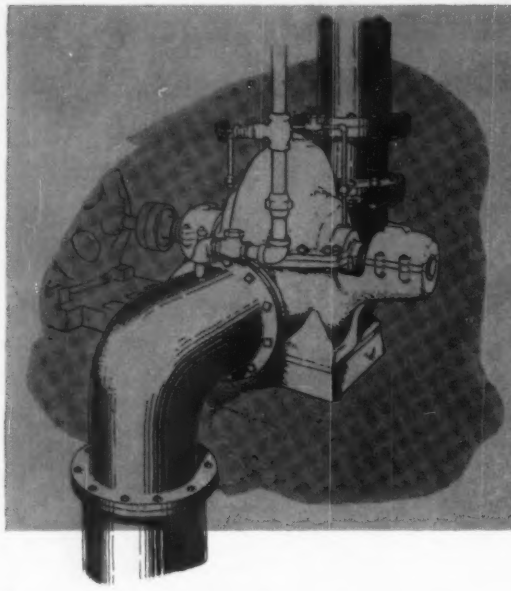
414 **Stationary diesels** are covered in bulletins 110 and 111. List typical applications, design features for low-speed power engines for continuous heavy-duty service. White Motor Co

415 **Turbine drives** for boiler-feed pumps are subject of 16-p bulletin GEA-6541. Lists units for steam-electric generation stations of 150,000-kw and up. General Electric Company

416 **Piston-ring** replacement is topic of 8-p brochure. Includes checking procedures for pistons and cylinders, installation info. Koppers Co, Inc

417 **Hydraulic cylinders** for 500 to 5000-psi service are subject of 32-p handbook. Includes info on column strength, force, selection factors. Miller Fluid Power Div

418 **Radial engines**—2-cycle diesel, spark-ignition gas and Duafuel—are described in 16-p bulletin 200A. Describes engineering and design features, including supercharging of spark-ignition units for an increase in rating of about 50%. Nordberg Mfg Company



Higher operating pressures and temperatures are creating challenging problems; a new valve standard is needed to cope with them. It now looks like it will be set at 4500 psi. Development of superalloys to handle temperatures of 1200 F and up is being pushed. New valve designs emphasize ease of operation, good flow characteristics to get higher flow capacity with lower pressure loss. At low end of pressure scale, there's interest in lightwall stainless-steel pipe and fittings for corrosive service. Steam-trap lines are putting more stress on operating economy, maintenance. Range of products offered in stainless steel, plastics and other new materials continues to increase.

R H Parke
Assistant Editor

This year's new equipment: Circle key numbers on Reader Service Card, page 222, to get more information

PIPING and VALVES

30 **Superalloy tubing line having h-t strength** is comprised of heat-resistant alloys that will not rupture under stress load of 25,000 psi at 1200 F when submitted to a 1000-hr test period. The alloy tubing is also reported to resist oxidation as well as other types of corrosion.—Superior Tube Company

31 **Crystalline tubing, in ⅛ to ¾-in. dia,** will be available in quantity after the first of year for broad industrial use such as heat exchangers. The tubing is pure white and opaque, with thermal-shock resistance reported equal to that of fused silica. Flexural strength is 17,000 to 23,000 psi.—Corning Glass Works

32 **Lightweight pipe covering for insulating** hot- and cold-water piping, l-p steam lines and refrigerant lines comes in hinged 3-ft sections, in wall thicknesses for iron pipe from ½- to 3-in. OD, and for copper tubing from ½ to 3-in. OD.—Ehret Magnesia Mfg Company

33 **Chemical relief valves will not leak** at line pressures below their set pressure. When they relieve excess pressures, they open wide instantly to permit maximum relief of liquid. There is no chatter or partial opening; valve is either closed tight during normal operations or wide open for relief of a blocked line. Units handle to 1500 psi.—Milton Roy Company

34 **Round-bolted bonnet, bolted-gland globe valve** copes with 150 to 800 psi. Screw or socket-weld end units are available in ¼ through 2-in. sizes. Valve bodies are forged steel.—Henry Vogt Machine Company

35 **Steel globe valve cuts pressure drop 70%** through internal contour design of the flow passages. Available in 1500- and 2500-lb classes from 10- to 18-in. sizes, they are intended primarily for steam-generating plants rated 500,000 lb per hr and larger, although there are many other applications.—Edward Valves, Inc

36 **Steel-wedge gate valves handle water,** steam, gas or air at 850 F and oil vapor to 1000 F. Valve body has a nonshock pressure-temperature rating of 420 psi at 1000 F, and 2000 psi at 100 F.—Walworth Company

37 **Line of 600-lb stainless-steel gate valves** meets API 660 and ASA B16.5 specs. Units come in ½- to 2-in. sizes, screwed and socket weld ends; ½ to 8-in. sizes, flanged and butt weld ends. They give rated pressures to 1125 F.—Cooper Alloy Corporation

38 **Spring-loaded valve insures protection** against overspeed of l-p turbines by addition of air-lift cylinder. In case of intercept valve failure, cylinder lifts valve to full discharge capacity at any pressure down to zero in 1/10 sec.—Crosby Valve & Gage Company

39 **Lubricated plug valve gives h-p gas regulation** with minimum pressure loss. Unit is pneumatically controlled, cylinder operated. Advantages reported are: operating ease, favorable flow characteristics, high capacity with low pressure loss.—Rockwell Mfg Co

40 **Pilot-operated 2-way valves** come in pipe sizes from 1½ to 3 in. Normally closed or normally open, they can be used with air, oil, water or vacuum at 0 to 500 psi. Units have only one moving part, are self-compensating and noncorrosive.—Airmatic Valve Inc

41 **Control valve with ductile-iron body** meets hot-water demands at 600 psi, 350 F. Stainless-steel stem, replaceable seat inserts are reported to give leak-free service. Normally-open or normally-closed, 2- and 3-way types have skirted seat rings to resist wire drawing.—The Sinclair-Collins Valve Company

42 **New concept of flow control** is offered by tapered-orifice valve reported to be nonclogging, nonfreezing. Gas or fluid flow is regulated by plug with tapered slot moving into and out of circular opening with circular sealing ring.—General-American Valve Co

43 **Union-bonnet disk, globe and angle valves** are rated for 150-psi steam, 300-psi water, oil or gas. They're suited for process and maintenance lines where tight shutoff is needed.—Ohio Brass Company

44 **Check valve has synthetic-rubber element** molded to a threaded nipple at its intake end. Element's other end is in a deflated position when flow stops, opens to full pipe area when flow is established. The soft, resilient element reduces line shock, absorbs foreign matter. It may be added to any standard pipe fitting and used as a foot valve, vertical or horizontal check valve, or an angle valve for compressor, refrigeration, lab applications.—Harman Equipment Company

45 **Trickle valve provides continuous discharge** of dust from cyclones and other dry dust collectors while maintaining positive gas seal. Ring type hinge on valve plate is reported to permit true alignment of surfaces that form the gas seal, preventing bending and giving continuous service under severe conditions of temperature, corrosion and abrasion.—The Ducon Company, Inc

46 **Suction, discharge valves for heavy-duty** ammonia compressors use multiple steel balls in place of a flat plate or poppet. Reported results: greater life, less resistance, better seating.—Ball Valve Company

47 **No seals or packings in miniature check valves** that operate at 5000 psi, −65 to 400 F. Designed for compact installation, they are slightly longer than unions of same tube size.—Republic Manufacturing Company

48 **Stainless-steel 2-way solenoid valve** is rated to 6000 psi for control of corrosive fluids, gases. Direct-lift unit comes in ⅛-, ¼-, ⅜-, ½-in. pipe sizes. Explosion-proof housing is optional.—Atkomatic Valve Co, Inc

49 **This 3-way solenoid valve can be manually set** and held in one position, and returned to its original position electrically. Unit has a forged-brass body, cast-iron operating mechanism. It is available for ac or dc in various enclosures.—Automatic Switch Company

50 **Outstanding features of butterfly valve line** are reported to be: ease of adjustment, assessibility and maximum actuator power delivery. Units come with either power, handwheel or lever actuation. Sizes range from 2 to 24 in., in cast iron, cast alloys or flame-cut carbon steel.—Mason-Neilan, a Division of Worthington Corporation

51 **Direct-acting solenoid-controlled valve** may be used wherever controlled draining or dumping of liquids is required. Absence of obstructions in valve reportedly eliminates collection of foreign matter, providing clean quick drain. Comes in 1½- and 2-in sizes, 15-watts ac; capacities to 118 gpm.—Automatic Switch Co

52 **Panel-mounted knob-controlled valve** for up to 200-psi pneumatic, hydraulic or vacuum service has one-piece bronze body, is said to feature leak-free construction, unrestricted flow capacity, simplified mounting and maintenance. Straight-through construction allows drop-in packer replacement.—Valvair Corp

53 **Diaphragm-operated 350-psi control valve** is designed for fast response in hot or cold raw water, steam, air or gas service. Unit is available in 3-way or reverse-acting types.—The Sinclair-Collins Valve Company

54 **Elimination of galling or wear** at the seating surfaces is reported feature of optional-flow, double-block-and-bleed full-opening valve. Unit handles gases, petroleum products.—Kerotest Mfg Company

55 **Shuttle valve charges and discharges** pressure cylinders through actuation of any one of two or more 3-way valves located at remote-control stations. "Anti-extrusion" setup is reported to give airtight service and eliminate danger of ring-seal cutting in normal operating pressure range.—Versa Products, Inc

FITTINGS and SPECIALTIES

56 **Complete line of welding fittings and flanges** of commercially pure grades of titanium are offered to match every schedule and size of titanium piping currently made. Titanium weighs 56% as much as stainless steel, has a high strength-to-weight ratio at up to 850 F, and is corrosion resistant. Good resistance to abrasion makes it suitable for piping radioactive materials. It's not corroded by salt water or marine atmosphere.—Tube Turns Div of National Cylinder Gas Company

57 **Stainless-steel serrated insert** with carbon-steel flange connects lightwall stainless-steel piping where possibility of future changes makes welding undesirable. Pipe is expanded directly into inset flange for leak-proof connection.—Horace T Potts Company

58 **Reusable fitting for h-t Teflon hose** has triple-locking feature reported to secure fitting to hose, components to each other so assembly cannot loosen from vibration. Two seals designed into the fitting are dynamically actuated by internal pressure, making leakage impossible.—Resistoflex Corporation

59 **Ductile-iron pipe fittings** are especially recommended where structural strength and thermal shock resistance are specified. Also when h-p sealing is vital to reduce hazards of fire or explosion. Pressure ratings of the complete line, including pipe-lock couplings, screwed and flanged fittings and companion flanges, have UL approval.—The Kuhns Brothers Company

60 **Aligning connector speeds assembly job** of stainless-steel piping systems. Connector provides a snug fit that holds pipe and fittings in position until welding or brazing secures the connection. It also makes possible in-place preassembly of complicated process-piping layouts.—Horace T Potts Company

61 **Corrugations in expansion joints** share movement of power and process piping systems equally. Suited to all-weather outdoor piping systems and for indoor systems operating on frequent on-off cycle, they protect piping and related equipment against damage from temperature change. Units are made from stainless steel in 3- to 72-in. dia and for traverses to 7½ in. in a single or 15 in. in a double unit. Standard joints cope with 150 to 300 psi, but can be made for higher pressures on special request.—Zallea Brothers

62 **Low-cost air-operated drive** operates large valves easily and quickly; a 10-in. 2500-lb valve under pressure

can be easily closed by one man in 2½ minutes from full open to seat contact. Final tight shutoff is then achieved by hammer-blow action of handwheel. Unit is a ring gear and pinion assembly fastened to Impactor handwheel and valve yoke. A portable air motor, operating from 90-psi plant compressed-air supply, turns pinion gear and handwheel.—Edward Valves, Inc

63 **Open-float thermostatic steam trap** for 0 to 150 psig provides faster warmup and efficient handling of entrainment in every stage from cold start to saturation temperatures. Fast warmup results from efficient venting and discharge of air and condensate in preliminary stage. All parts are accessible for service without removing trap body from line.—Wright-Austin Co

64 **Only moving part in steam trap** is valve assembly —bucket, valve and impeller—which operates as integral unit. Impeller changes seating position of valve at each discharge, prevents uneven wear of valve and orifice, wire drawing, steam leakage.—H O Trerice Co

65 **New construction of float-thermostatic trap** is reported to simplify inspection, maintenance and installation. Operating element is one unit, can be removed without disturbing inlet and outlet connections to semi-steel trap body. Unit is suitable for 125-psi steam.—Sarco Company, Inc

66 **Engineered for light condensate load** applications, impulse steam trap permits economy of operation and maintenance. Lever valve pivots about a fulcrum, discharges air and condensate at full capacity at startup and snaps shut when steam reaches the trap. Lever action is reported to result in quietier operation. Replaceable valve-seat assembly and stainless-steel construction are two features. Available in ½-in. size, for operating at 8 to 600 psig.—Yarnall-Waring Company

Free bulletins: Yours for the asking. Circle key numbers on Reader Service Card, page 222, to get your copies

PIPING and VALVES

419 **Plastic ductility** of piping containing welded joints at 1200 F is subject of 16-p report. Pittsburg Piping and Equipment Co

420 **Quality control** for steel tubing is covered in 24-p booklet TB-420. The Babcock & Wilcox Co

421 **Pvc pipe** (polyvinyl chloride) is topic of 12-p catalog. Includes application tables, temperature factors. Alpha Plastics Inc

422 **Dielectric values,** power factor, volume resistivity of polyvinyl-chloride pipe is discussed in 30-p catalog. A M Byers Co

423 **Superalloy tubing** is subject of 10-p bulletin 70. Contains data on 16 alloys for 25,000-psi 1200-F service. Superior Tube Company

424 **Tubing tolerances** are explained in data chart Sec. B No. 1. Covers both seamless and welded mechanical tubing and steel tubing, pipe. Peter A Frasse & Co, Inc

425 **Titanium tubing,** present status and future potential, is covered in 8-p reprint TR-550. The Babcock & Wilcox Company

426 **Cement-lining** process for pipes from 4- to 144-in. dia is described in 20-p catalog. Centriline Corp

427 **Hot-pipe insulation** for underground application is discussed in 12-p folder Z-1. Zonolite Co

428 **Pipe insulation** for 1200 F is subject of 4-p bulletin A-407. The Eagle-Picher Company

429 **Complete line** of cast- and forged-steel valves for power, petroleum, chemical, marine and industrial applications is described in 92-p catalog 14. Visual index shows every valve cataloged. Data includes ASA dimensions, ASA pressure-temperature ratings and ASTM basic materials and specs. Edward Valves, Inc

430 **Bronze** brazed-joint valves, corrosion - resistant nickel - iron valves and forged and cast-steel valves are described in 28-p bulletin CD-2. Valve figure numbers are indexed for finger-tip reference. The Ohio Injector Company

431 **Valves** for high pressures and temperatures are detailed in 12-p bulletin B-453. Includes data on materials, design. Yarnall-Waring Company

432 **Solenoid valves** for reactors are subject of 4-p brochure. Automatic Switch Company

433 **Solenoid valves** are listed in 20-p catalog 200. Includes dimensions, specs. Atkomatic Valve Co, Inc

434 **Flow diagrams,** ratings, engineering data on 2- 3- and 4-way solenoid valves are given in 8-p stock list. Automatic Switch Co

435 **Solenoid valves** for liquid and suction-line refrigerant application are detailed in four 2-p bulletins 271, 272, 273, 274. Controls Company of America

436 **Sliding-gate** temperature-control valves are topic of 6-p bulletin J-180. Jordan Industrial Sales Div of OPW Corp

437 **Magnetic** and motorized valves for air, water, gas, steam, oil and refrigerants are listed in 24-p catalog V - 58. Includes flow charts. Mercoid Corporation

438 **Automatic** shutoff valves for overload protection of gages and instruments are listed in 2-p bulletin. Sprague Engineering Corp

439 **Water - control** valves are described in 8-p bulletin G-5A. Golden-Anderson Valve Specialty Co

440 **Union-valve** combination is discussed in 4-p folder WV-454. Worcester Valve Co, Inc

441 **Steel valve,** full-opening double-block-and-bleed nonlube type, is topic of 4-p brochure. Kerotest Manufacturing Company

442 **Pressure-reducing** valve is described in 2-p data sheet 1051. Copes-Vulcan Div, Blaw-Knox Co

443 **Semi-steel** valves are subject of 43-p bulletin V-203 Rev 1. Has photos, drawings, description of principal valve types, plus descriptions of lubricants. Rockwell Manufacturing Company

444 **Valves** for automation in steel mills are discussed in 16-p bulletin SM-1. Includes schematics of piping, valve setups. Golden-Anderson Valve Specialty Co

445 **Gate valves,** check valves and fire hydrants are detailed in 244-p catalog 57. Illustrated and diagrammed, it gives referencing info and specs. Darling Valve & Manufacturing Company

446 **Liquid-level** gages and valves are discussed in 8-p bulletin 305. Gives dimensional drawings. Jerguson Gage & Valve Company

447 **Ductile-iron** valves are described in 6-p folder. Kennedy Valve Manufacturing Company

448 **Thermostatic - expansion** valves are topic of 6-bulletin package. Gives application info, full specs. Controls Company of America

449 **Swing check valves** for steam and water-line service are subject of 4-p bulletin 8K. Schutte and Koerting Company

67 **Y-sediment strainer of polyvinyl chloride** is designed for service on alkalis, acids, inorganic salt solutions. Unit has service rating of 150 psi at 75 F and 75 psi at 150 F. Comes with threaded, solvent-weld socket or flanged ends, ½ to 2 in.—Walworth Company

68 **Dangerous pipeline openings are pinpointed** by red bands of signal bull plug. Easily seen, they give immediate warning of unsafe conditions or fire hazards. Unit incorporates a permanently attached chain and ring at unthreaded end to prevent loss. Chain may be spot welded to line, or ring may circle piping. Plugs are available in steel and stainless steel in ¼- to 2-in. pipe sizes.—Crawford Fitting Company

69 **High-pressure purifier for air, steam** and process vapor and gas line use withstands 15,000 psi, with 12,050-psi maximum service pressure. Pressure parts are of alloy steel with special gaskets and pipeline connections. Unit has no moving parts, filters or mesh screens; operates by 2-stage principle using centrifugal force to guide entrainment laden vapor through a series of vanes and baffles.—The V D Anderson Company

70 **Transistorized portable pipewall gage** weighs 7½ lb, is used to measure absolute pipewall thickness directly on pipes ranging from 2- to 8-in. nominal dia. Principle of radiation absorption is used, so nonferrous and plastic piping may be measured. Reproducibility and resolution of better than 0.010 in. are achieved in pipewalls from 0- to 1-in. thick.—Industrial Nucleonics Corporation

71 **Lightweight planetary gear operator** adapts wrench-adjusted h-p valves already in service to gear operation. Unit has 5:1 gear ratio, 4:1 mechanical advantage. One full turn of the gear operator closes or opens the valve.—Rockwell Manufacturing Company

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450 **Float valves,** single-seat design for 15 to 150 psi, are described in 2-p catalog sheet. Atlas Valve Company

451 **Nozzle** safety-relief valves are listed in 44-p catalog FE-118. Gives sizing factors, capacity charts, dimensions, weights. Farris Engineering Corp

452 **Forged-steel** globe valves are covered in 4-p bulletin DH-213. Lists materials, dimensions. American Chain & Cable Co, Inc

453 **Multiport** relief valves for steam systems are reviewed in 8-p bulletin 5200-A. Includes specs for vertical, horizontal, angle units in 4 to 48-in. sizes. Cochrane Corporation

454 **Bronze globe,** angle and check valves are described in 4-p bulletin. Walworth Company

455 **Manually-operated** 4-way hydraulic valves are covered in 12-p catalog 210. Rivett, Inc

456 **Vacuum** valve design is topic of 2-p data sheet. Includes dimension chart. Vacuum Research Co

457 **Duplex** transfer valves are listed in illustrated bulletin containing design, performance info. A W Cash Company

458 **Steam-regulating** valves with pilots for fast- and slow-heating exchangers are topic of 6-p bulletin 1012. Spence Engineering Co, Inc

459 **Refrigeration,** air-conditioning valves, accessories, fittings are discussed in 20-p catalog. Superior Valve & Fittings Co

460 **Differential** valve recommended for use with simple level control is topic of 2-p bulletin. Copes-Vulcan Div, Blaw-Knox Co

461 **Safety-relief** valves for hot-water space heating boilers are covered in illustrated 4-p bulletin P-33. McDonnell & Miller, Inc

462 **Valves** for instrument piping and general use are covered in 4-p bulletin 302. Jerguson Gage & Valve Company

FITTINGS, SPECIALTIES

463 **Welding fittings** and flanges, 4-in. nominal pipe sizes, are tabled in 4-p technical bulletin FDC-261. Full specs, dimensions. The Babcock & Wilcox Co

464 **Quick coupler** for piping, hoses, equipment is described in 8-p catalog F-10-R. Jordan Industrial Sales Div of OPW Corp

465 **Hose couplings,** stems, swivels and accessories are listed in 32-p catalog 57. Includes photos, specs. J N Fauver Co, Inc

466 **Hydraulic** tube fittings are described in 28-p catalog 556. Gives design, installation info; specs. Flodar Corporation

467 **Self-locking** connectors are subject of 24-p catalog containing specs, diagrams, wiring info. Avnet Interlock Corporation

468 **Planetary gear** operator, for use with wrench-operated h-p valves, is discussed in illustrated 4-p bulletin V-610. Contains selection and installation details. Rockwell Manufacturing Company

469 **Valve controls** are discussed in 6-p bulletin 4-57. Includes ratings, photos, diagrams. Philadelphia Gear Works Inc

470 **Manual remote** valve controls are topic of 20-p design manual 5811. Includes data on flexible-shaft and standard reach-rod controls. Stow Manufacturing Company

471 **Steam specialties** are described in 60-p catalog 69. Includes steam-trap pressure capacity and size tables, dimensions. Strong, Carlisle & Hammond

472 **"How to select** steam traps and other fluid specialties" is title of 40-p engineering manual. Contains sections on installation, piping details. The V D Anderson Company

473 **New method** in steam-trap piping is described in 4-p catalog 601. Velan Engineering, Ltd

474 **Steam-trap folder,** 6-pp, has tables, diagrams for selecting traps for any condensate-discharge condition. Crane Company

475 **Impulse** steam traps are discussed in 8-p bulletin T-1742. Includes installation, capacity data. Yarnall-Waring Company

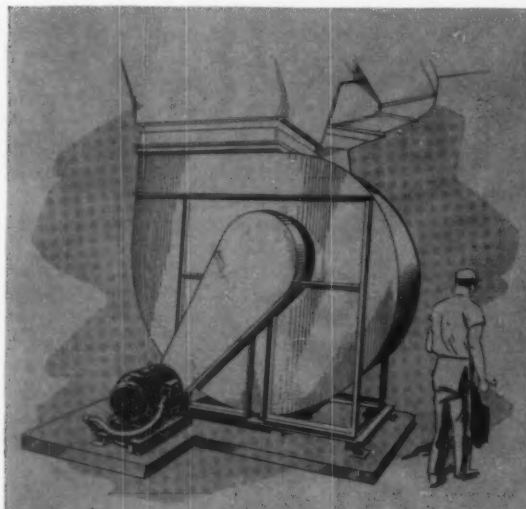
476 **Steam traps** for industrial process are topic of bulletin HPT-1. Covers cast-bronze, semi-steel units. Barnes & Jones, Inc

477 **Expansion joints** are subject of 80-p catalog EJC-581. Gives data for rating joints subjected to axial or lateral movement or angular rotation. Covers units from 3- to 72-in. diameter. Badger Manufacturing Company

478 **Rubber** expansion joints and flexible pipe are covered in 6-p bulletin 575. Gives data for ½- to 72-in. ID units. General Rubber Corporation

479 **Expansion joints** are topic of 12-p bulletin EJ-1916. Contains dimensions, selection data. Yarnall-Waring Company

480 **Ductile-iron** fittings are described in 4-p catalog PL-1. Gives pressure ratings, installation info. The Kuhns Brothers Co



Absorption cooling units, teamed alongside conventional heating schemes, are competing with the heat pump for top attention. Neither are new, but you can expect even wider acceptance of the dual-purpose idea in the years ahead. Both are attractive from a purely flexible angle. Which to select usually is a matter of straight economics. Some consultants use the following list in making a cost check: (1) What is ratio between heating and cooling load? (2) Can present equipment be used in any way? (3) Do electric power rates compare favorably with fuel costs? (4) What will it cost for space, maintenance? Finally, look at total load: To date, limit on air-source heat pumps is 1000 tons; water supply often limits others.

J. W. Follansbee

Assistant Editor

New equipment designs: Circle key numbers on Reader Service Card, page 222, to get further information

72 **Multi-zone air-distributing units** are offered in seven basic sizes for total capacities of 4000 to 34,000 cfm. Outlet of the blow-through type units is divided to serve either cooled or heated air or a controlled mixture to as many as 16 separate zones.—Sturtevant Div, Westinghouse Electric Corporation

73 **Flexible design of heating-ventilating unit** permits a wide selection of combinations and arrangements —unit, coils, accessories can be built up in any sequence to meet needs of specific job. Eleven basic sizes handle 600 to 66,000 cfm.—American Blower Div, American-Standard

74 **Multi-zone single station air conditioner** is reported to eliminate bulk and expense of individual units. Eight sizes have air capacities of 3400 to 36,000 cfm. Exclusive feature is automatic filter section, claimed to (1) assure constant air delivery at all times (2) make filter changing automatic (3) cut maintenance costs.—American Air Filter Company, Inc

75 **New concept of matched performance ratings** using oversized condensers is feature of air-cooled commercial air-conditioning units. Twelve capacities are obtained by using six base units with selected quantities from three condenser sizes. Result: Inventory problems are minimized while permitting more accurate selection of specific capacity to fit a given need. Units are rated to 254,000 Btu per hr gross cooling capacity. —American Blower Div, American-Standard

76 **Packaged system for water cooling to 350 tons** is fully factory-assembled including controls, motor starter, control piping and wiring. Additional design drawings for normal applications are not necessary. Set on one-piece rigid base, entire system is reported to be easily trucked, rigged.—York Corporation

77 **Industrial fan wheel copes with fibrous material** such as wool, cotton rayon and trim from corrugated box and paper machines. Feature is sloping surface back of fan blades to prevent material from clinging. Wheel sizes range from 9½ to 60½ in. Steel-plate exhauster moves, depending on need, 200 to 50,000 cfm air at static pressures to 15 in.—Chicago Blower Corp

78 **Abrasive gases at elevated temperatures** are handled by series of heavy-duty mechanical-draft fans. In ratings to move 10,000 to 500,000 cfm and pressures to 70 in. water, these centrifugal fans can operate in a temperature range from 20 to 850 F. Applications include: steam boiler gas recirculation, flyash precipitator purging, induced draft for waste-heat boilers.—Sturtevant Div, Westinghouse Electric Corporation

79 **Substantial savings in floor space** is feature of Type RAS rotary-positive blowers. Compact design results from vertical setup of impellers to provide horizontal inlet and discharge connections. The blowers handle both air and gas, are available in 36 sizes covering capacities from 2000 to 14,000 cfm at 6 psig and from 1500 to 8000 cfm at 10 psig. — Roots - Connersville Blower, a Division of Dresser Industries, Inc

80 **Low-silhouette cooling tower** has capacities ranging upward from 75 tons. It features all-steel structural members that are hot-dipped galvanized after fabrication for extra corrosion protection. Louvers, casing, distribution system, fan deck are of asbestos cement. Deck fill is redwood.—J F Pritchard & Company

81 **Compact general-purpose cooling tower** has 15- to 200-gpm capacity, is 44- to 84-in. high. Multi-finned internal decking is of noncorrosive plastic. Notched plastic sheets are reported to provide four times more water-to-air exposure than conventional towers. All metal parts are hot-dip galvanized.—Binks Mfg Co

82 **Natural-draft cooling tower** has no motors, gears, fans; needs no mechanical maintenance. Air draft is self-generated in reinforced concrete stack. Filling, hot-water system are of asbestos cement.—Hamon, Inc

83 **High-efficiency centrifugal roof ventilator** comes in 1/10 to 10-hp sizes. Wheel diameters range from 12¼ to 36½ in., capacities are 1100 to 25,000 cfm. Various motor selections include single phase, 115/230 volt, 60 cycle; and 3 phase, 220/440 volt, 60 cycle. Backward-curved wheels are dynamically balanced, taper locked to shaft.—The Peerless Electric Company

84 **Direct-drive extended-shaft orifice fan** is designed for operations where motor must be kept out of air stream. Examples: exhausting gases or corrosive fumes, circulating h-t air for drying. Aerodynamic blade design combines h-p characteristics with low noise level. Sizes are 24 to 42 in.—Chicago Blower Corporation

85 **Low-cost packaged ventilating units** have wide versatility in the ventilating and air-cooling fields. Direct-drive exhausters (8 models) deliver to 2290 cfm, and belt-driven models (2) move to 1800 cfm. Standard finish for all units is a weather-resistant zinc-chromate primer.—The General Blower Company

86 **Direct-connected cradle-mounted fans** deal with man- and product-cooling jobs; drying, recirculation and similar applications. Five sizes, 16 to 36 in., have air ratings to 18,700 cfm.—Robbins & Myers, Inc

87 **Redesigned belt-driven duct fan** operates under corrosive atmospheres and extreme temperature ranges. New axial airfoil blade design is reported to produce higher pressure characteristic while cutting noise. Unit is suitable for operating in acid fumes, explosive vapors, dust and gases.—Chicago Blower Corporation

88 **Noise-reducing constant-volume controller** is designed for use with high-velocity, high-pressure double-duct air-conditioning systems. Company engineers report that unit maintains a constant flow pattern within each conditioned space regardless of number of mixing units, length of duct runs or differences in pressure between hot and cold ducts.—Johnson Service Co

89 **Single-unit hot-gas washer** cuts most air-pollution problems, resists temperatures to 2000 F. Compact washer is less than 15-ft high, can be used for incinerators, melting furnaces, chemical processes and similar conditions where hot air or gases cause dust-pollution problems. Unit comes with either manual or automatic sludge removal.—Lehigh Fan & Blower Div, Fuller Co

90 **Scrubber is 97 to 99% efficient,** operates by impinging dusty gas at high velocity into a pool of scrubbing liquid. Fast impingement causes gas and dust to penetrate deeply into the liquid bath, assuring high collection efficiency. Unit has a pressure drop of 5 to 10 in. water, and liquid ratio is 1:5 gpm per 1000 cfm.—Western Precipitation Corporation

91 **Efficient forced-draft fan** for central power stations and heavy industrial service is engineered around an airfoil backward-curved nonoverloading centrifugal wheel. Mechanical efficiencies to 92% are reported. Hollow-section airfoil blades work on airplane-wing principle: smooth passage of air over blade surface cuts eddy currents, lowers noise level 20 to 40%, requires less horsepower. Fan furnishes static pressure from ¼ to 32 in.; volumes range to 1,097,940 cfm, temperatures to 900 F. Inlet vane controls provide fan-output regulation.—Chicago Blower Corporation

92 **Dehydrator uses nondusting bead desiccant** to remove water-vapor from the air. Air is passed through a 40-micron filter and along an extended flow path for maximum exposure before leaving the dehydrator through a 10-micron filter. An indicator tube shows when relative humidity of air leaving the dehydrator exceeds 4%. Unit operates at 35 psig.—Farr Company

93 **High-velocity electronic dust precipitator** has a reported size reduction of 30% in face area, 50% in cubic requirement over conventional precipitators. Principle of operation is collection of charged dust particles on metal plates. An electrical charge is imposed on entering dust particles through ionization. After passing the ionizing unit, dust particles are precipitated on fixed plates of opposite electrical charge. Collection efficiencies of the sectionalized units can reach 97%.—American Air Filter Company, Inc

94 **Ruggedly built oil-fired space heaters** are available in six sizes ranging from 100,000 to 1,000,000 Btu per hr. The compact portable units provide temporary heat for maintenance shops, boiler rooms, other unheated areas. They also are useful for thawing out frozen equipment and material. Unit has automatic electric ignition, an electrically driven fan, enclosed combustion chamber and twin disk control to aid combustion.—Stow Manufacturing Company

95 **Glass-cloth filters operate at 600 F,** are reported to resist deterioration from all corrosive substances except fluorine and hydrofluoric aicd. Housing is said to take maximum advantage of cloth filtration, yet prolong bag life. Filter bags are single-hung tubular type, made of fibrous-glass cloth treated for protection against fracture.—Dracco Corporation

96 **Renewable-media filter line** cuts installation time, permits easy storage on the job site, eliminates rigging for installation. Principle of operation is centered in a moving filter curtain of bonded glass-fiber material that traps dust particles in the entering air. Filter curtain unrolls downward across filter face, forms disposable package at the bottom. Only maintenance required is periodic replacement of filtering media. Unit comes in sections 3-, 4- or 5-ft wide, 5- to 15-ft high. Galvanized construction minimizes corrosion.—American Air Filter Company, Inc

97 **Cabinet cloth-filter dust collector** contains 150 sq ft of filters that clean a maximum of 600 cfm of air. Improved filters are made of fine-woven cotton, treated to resist sparks. Maintenance is cut by a dust-storage drawer with 2-cu-ft capacity. The 1-hp motor moves 600 cfm of air through a 4-in. inlet at 4.0-in. static pressure, 400 cfm through a 3-in. inlet at 5.0-in. static pressure, or 350 cfm through each of two 3-in. inlets at 4.0-in. static pressure. Cleaned air can be recirculated or exhausted outside.—Torit Manufacturing Co

98 **Automatic dust-precipitator unit** collects small-sized particles, is reported capable of very high recovery efficiencies. Dust is recovered by passing it through unit's electrostatic field: particles become electrically charged and attracted to metal plates placed in gas stream. Unit is reported to require no maintenance or parts replacement. It comes sealed in electronic potting compound and is unaffected by moisture, dust or humidity.—Western Precipitation Corporation

New free bulletins: To get copies of those you want, circle key numbers on handy Reader Service Card, page 222

481 **Centralized** air-conditioning units for conventional and multi-zone applications are described in 72-p catalog 39ACW-55. Contains selection data, mechanical and guide specs, performance curves, tables. Carrier Corporation

482 **Air conditioning** and refrigeration equipment is subject of 34-p bulletin 80-E. Contains refrigeration tables, physical descriptions, application info. Frick Company

483 **Single station units** for controlled air conditioning are detailed in catalog 7558. Includes dimensional, performance, installation data. Young Radiator Co

484 **Air-conditioning units** are topic of 54-p bulletin 786. Discusses design features, accessories, selection steps, capacities. American Air Filter Co, Inc

485 **Air treatment,** distribution products are covered in 32-p bulletin D-5199. Has sections on air handling, air conditioning, heating. Sturtevant Div, Westinghouse Electric Corporation

486 **Disribution control** and air conditioning are themes of illustrated 4-p bulletin F-8326. Barber-Colman Company

487 **Air engineering** for process industries is subject of 8-p bulletin 135. Covers aftercoolers, air conditioners, liquid coolers. Niagara Blower Company

488 **Automatic controls** for heating and air-conditioning systems supply text for 52-p catalog 26. Fully describes, illustrates line of electric thermostats, pressure controls, humidistats, unit ventilator controls. Barber-Colman Co

489 **Heavy-duty compressors** for all types of refrigeration service are illustrated, described in 18-p bulletin 112-J. Ten 2-cyl and four 4-cyl units make up the line. Frick Company

490 **Forward-curved** mechanical-draft fans are topic of 4-p bulletin FMD-101. Includes dimensions. Chicago Blower Corporation

491 **Airfoil** mechanical-draft fans for central power stations and heavy industrial service are detailed in 4-p bulletin AMD-101. Chicago Blower Corporation

492 **Rotary** positive blowers are described in 8-p bulletin AF-258. Roots-Connersville Blower, Div of Dresser Industries, Inc

493 **H-t fans** that handle 600 to 80,000 cfm at temperature to 1650 F are described in 20-p bulletin HF-100. Gives selection data, specs. General Blower Company

494 **Cycloidal blowers** for vacuum service are discussed in 14-p bulletin VP-158. Color cutaway shows features. Roots-Connersville Blower, Div of Dresser Industries, Inc

495 **Roof ventilators,** centrifugal belt- and direct-drive types, are subject of 12-p bulletin SDA-220. The Peerless Electric Company

496 **Ventilating fans,** belt-driven models, are covered in 26-p bulletin UVS-104. Includes performance tables, selection data. General Blower Company

497 **Tubular** centrifugal fans for air conditioning, ventilation and processes are detailed in 16-p catalog. Curves, specs are given for direct and V-belt drive units. Dryer Electric Corporation

498 **Propeller fans** comprise text of 32-p catalog A-109C. Contains air-delivery info, specs. Hartzell Propeller Fan Company

499 **Blower utility sets** are subject of 52-p catalog 8314. Details size ranges, configurations of fan wheels and motors. American Blower Div, American Standard

500 **Mechanical-draft fans** with airfoil blades are topic of 10-p catalog 1321. Sturtevant Div, Westinghouse Electric Corporation

501 **Unit heaters** are subject of 26-p booklet B-1523. Design, construction, application data is given. Sturtevant Div, Westinghouse Electric Corporation

502 **Industrial heaters** are detailed in 26-p bulletin 750A. Includes graphs, charts, dimensions. American Air Filter Co, Inc

503 **Heating,** ventilating units are described in 48-p catalog 8927. Sections cover coils, fan selection, accessories. American Blower Div, American-Standard

504 **Heaters** for industrial applications are covered in 4-p bulletin. Lennox Industries Inc

505 **Electric heater** hookups, heat-requirement nomographs for storage tanks handling viscous fluids are detailed in 8-p bulletin 202A. Hynes Electric Heating Div, Turbine Equipment Company

506 **Ventilating,** heating, air-conditioning units are described in 12-p bulletin 701. Separate section on automatic filters. American Air Filter Co, Inc

507 **Air-moving** equipment ratings are included in bulletin 153-57. Typical test setups and performance curves for fans and ventilators are included. Air Moving and Conditioning Association

508 **Air and steam** cleaners are subject of 4-p folder 502. Gives piping details, sizing data. The V D Anderson Company

509 **Electronic** air cleaners with automatic operation are discussed in illustrated 2-p specification sheet 1460. Sturtevant Div, Westinghouse Electric Corporation

510 **Dust control** is topic of 16-p bulletin 274B. Presents wiring diagrams, tables, dimensions. American Air Filter Co, Inc

511 **Air filtration** is subject of 6-p booklet. Filter performance and selection data is given. Flanders Filters, Inc

512 **Automatic control** package for hot- or chilled-water ventilators is described in 3-p data sheet. Barber-Colman Company

513 **Centrifugal precipitator** is detailed in 4-p bulletin 276. American Air Filter Co, Inc

514 **Dual-duct** air-mixing units are subject of 8-p bulletin DD-4. Buensod-Stacey Inc

515 **Cooling towers,** induced-draft packaged units, are discussed in 4-p circular SP-1. Gives complete specs. Mason Products, Inc

516 **Packing arrangements** for cooling towers are discussed in 8-p booklet. Comparative values of redwood bars and grids are covered. J F Pritchard & Co

517 **Cooling towers,** propeller-fan type, are described in 8-p bulletin EC-500. Gives rating data for belt- and direct-drive, take-apart models. Halstead & Mitchell

518 **Natural draft** cooling towers for all capacities, climates and industries are described in illustrated 2-p bulletin. Units have no moving parts. Hamon, Inc

519 **Refrigerating machines,** hermetic centrifugal units, 90 to 1100-ton capacity, are topic of 28-p catalog 19C-104. Carrier Corporation

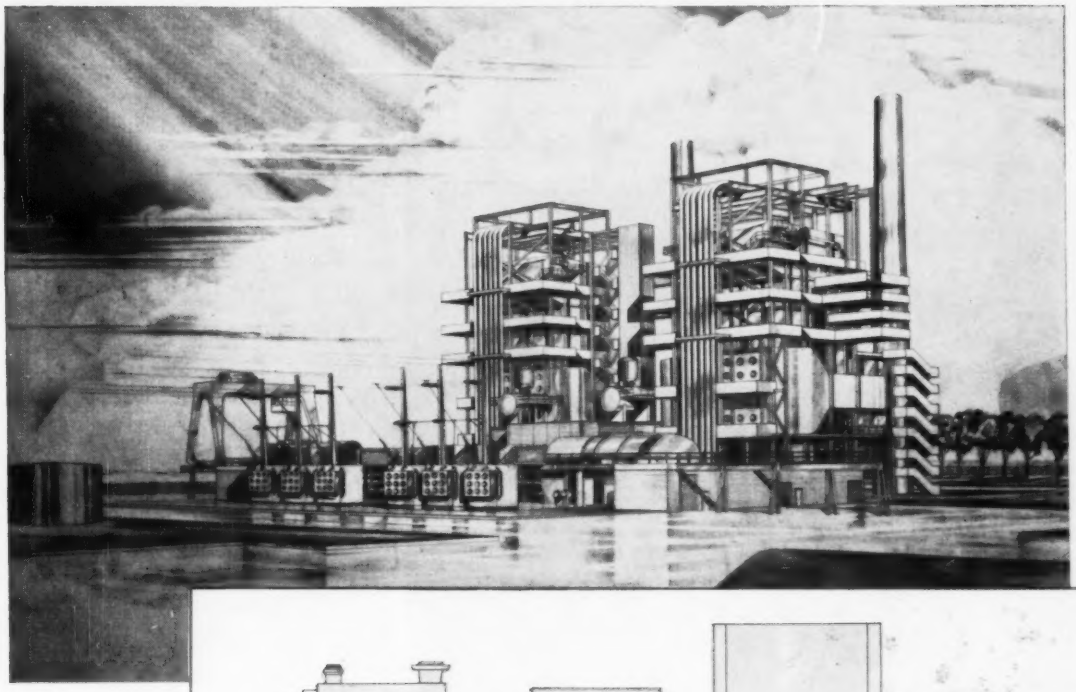
520 **Packaged water chillers** for air conditioning and refrigeration, 18 to 250 tons, are described in fully illustrated 36-p bulletin EM-213. York Corporation

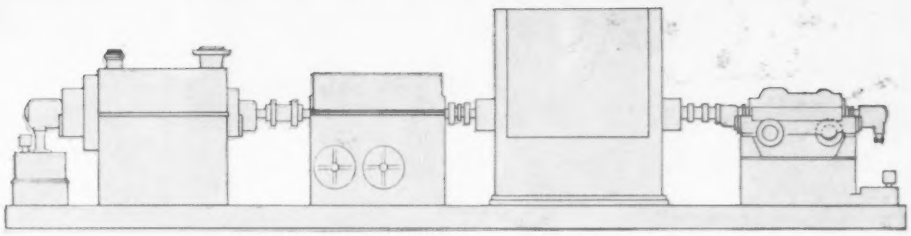
521 **Ice makers** for industry are described in 8-p bulletin 54-F. Fully illustrated. Frick Company

522 **Oxycat systems** for air-pollution control and heat recovery are described in 8-p bulletin. Includes case histories. Oxy-Catalyst, Inc

523 **Scrubber** is described in 4-p brochure 500. Includes cutaway views. Centrifix Corporation

For Southern California Edison Company's
new Huntington Beach Steam Station...





CHTA boiler-feed pump

HMTA condensate booster

Ingersoll-Rand pumps will handle all boiler-feed water

WHEN completed, Southern California Edison Company's new Huntington Beach Station will have a name plate capacity of 820 MW of power ... with four cross-compound turbines and oil-and-gas fired boilers. For the first two units now under construction, Southern California Edison (and Bechtel Corp., engineer and constructor) has purchased 10 Ingersoll-Rand pumps to handle all boiler-feed water.

One of the arrangements of boiler-feed pump and condensate-booster pump is shown above. The feed pump at left is an I-R double-case pump rated 2020 gpm at 6400 ft TDH. The booster pump at the opposite end of the driver is an I-R horizontally split unit rated 1850 gpm at 1970 ft TDH.

In addition, I-R is supplying the axial inlet surface condensers for each generator unit ... plus the condensate, circulating and heater drain pumps, vacuum pumps and steam-jet ejectors.

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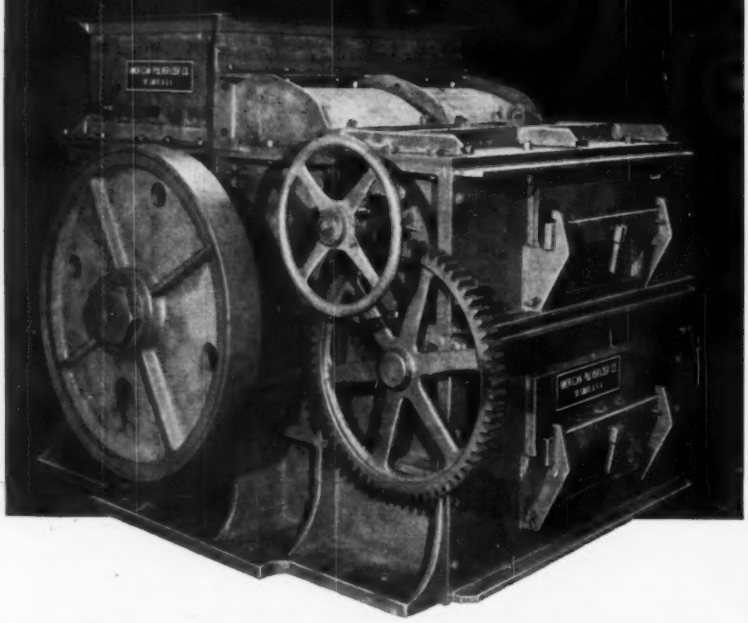

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WELDING

NEW WELDING EQUIPMENT: To get the complete story, circle key numbers on Reader Service Card provided on p 222

99 **Drooping-voltage** arc welders are available in three types—350-amp dc, 300-amp ac/dc and 300-amp ac/dc Heliwelder. All machines provide 115/230-volt, 10-kw, single-phase 60-cycle power when operated as power plants. They have 115-volt, 1-kw dc auxiliary power available for operating lights and power tools while welding.—Air Reduction Sales Co

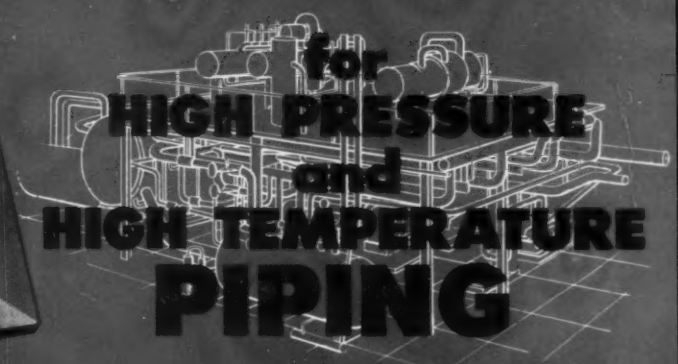
100 **Wire-feed welder** handles semiautomatic open-arc hardsurfacing, uses 7/64-in. wire. Unit can resurface most equipment parts subject to abrasion, impact or compression. Weight is 70 lb, making job-to-job transfer a one-man operation. Welder operates from most dc power sources, needs only two electrical connections.—Alloy Rods Company

101 **M-g machine** is designed for application of gas-shielded metal-arc processes where equal burnoff rate and wire-feed must be maintained. Its rising volt-ampere curve reacts instantaneously to all wire-feed speed changes to maintain constant arc length. Current rating is 450-amp continuous; weight, 840 lb; height, 28¾ in.; width, 20⅝ in.; length, 34⅝ in. —Air Reduction Sales Company

102 **Portable handgun** and control handles filler wire down to 0.020 in. It is the first fully portable gun capable of welding light gage metals; it's particularly effective in welding aluminum. Weight is less than 4 lb, when loaded.—Westinghouse Electric Corp

(*Continued on page* 242)

STEEL FORGINGS by MESTA



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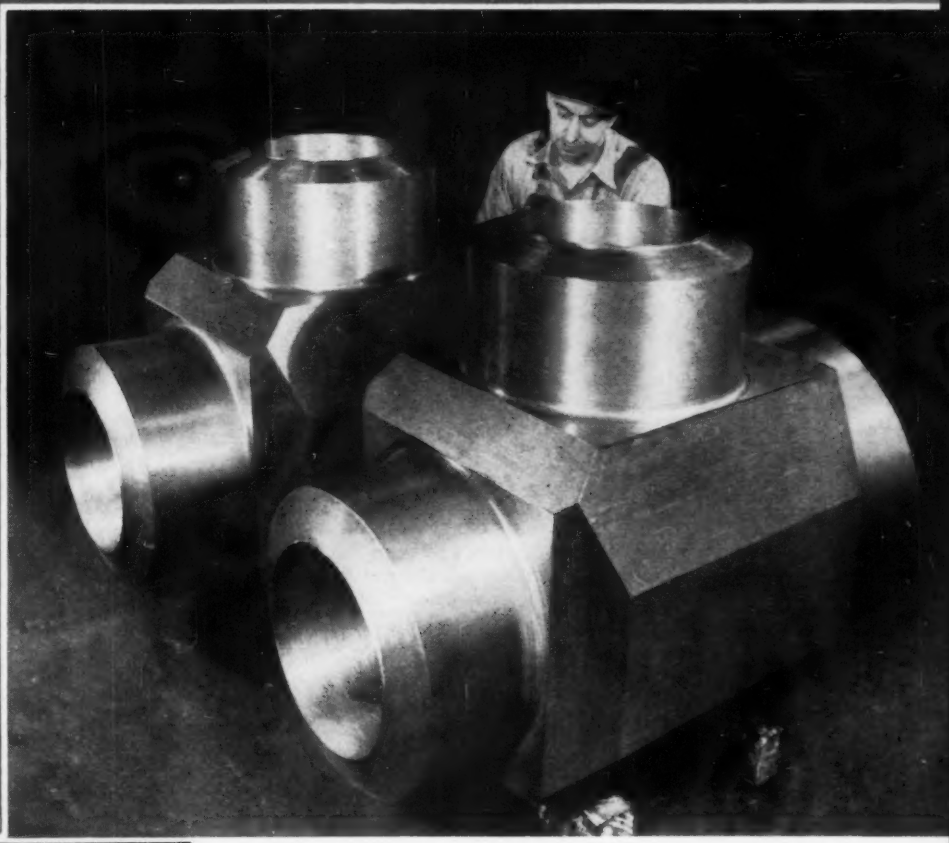

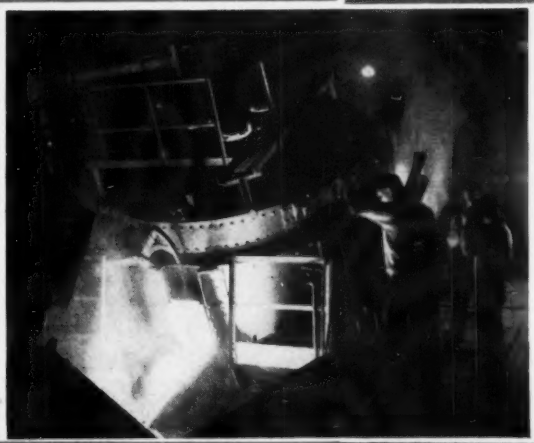

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IN HIGH PRESSURE SERVICE

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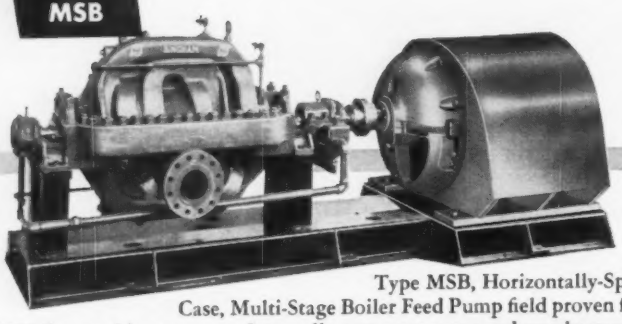
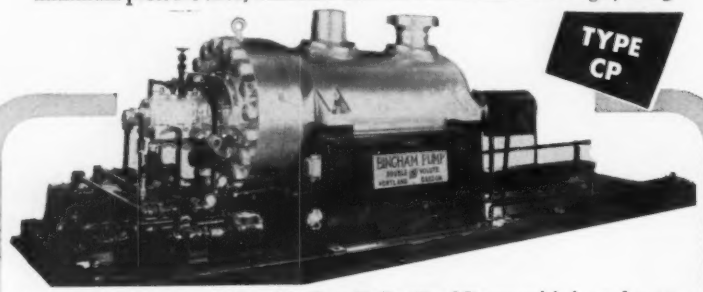


Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

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WELDING

Begins on page 240

103 **Electrode** is for application of hardsurface overlay to low-alloy steels and cast irons where severe abrasive conditions are present. It has smooth arcing characteristics and is operable in all positions. No special techniques regarding weld metal deposition are required. Available in 5/32-, 3/16- and ¼-in. diameters.—The International Nickel Co, Inc

FREE WELDING BULLETINS: To get those you want, circle key numbers on Reader Service Card provided on page 222

524 **Submerged-arc welder** is subject of 6-p bulletin 5205.1. Includes how-to photos. The Lincoln Electric Company

525 **Combination welders,** ac and dc types in 300, 400 and 500 amp, are subject of 4-p bulletin. The Lincoln Electric Company

526 **Supplies, accessories** are listed in 4-p catalog 9-13. Covers all types of welding rods, fluxes, brazing alloys. Air Reduction Sales Co

527 **Root-pass weld** is discussed in 12-p bulletin. Describes tack welding, gas protection of inner surface. Arcos Corporation

528 **Weldors' guide** EW-201 is 60-p booklet of arc-welding information. Gives details on metals and electrodes, definitions of terms, explanation of AWS classification numbers. Hobart Brothers Co

529 **Welding** of 4130 steel is topic of 8-p bulletin ADR-112. Air Reduction Sales Company

530 **Magnetic clamps** for setting up welding work, other welding aids are detailed in 4-p folder. Aronson Machine Company

531 **Arc welding** with bronze electrodes, filler rod and wire is discussed in 24-p catalog W-17. Ampco Metal, Inc

532 **Welding-wire guide** is 84-p booklet ADC 873. Contains sections on chemical composition, mechanical properties, operating procedures. Air Reduction Sales Company

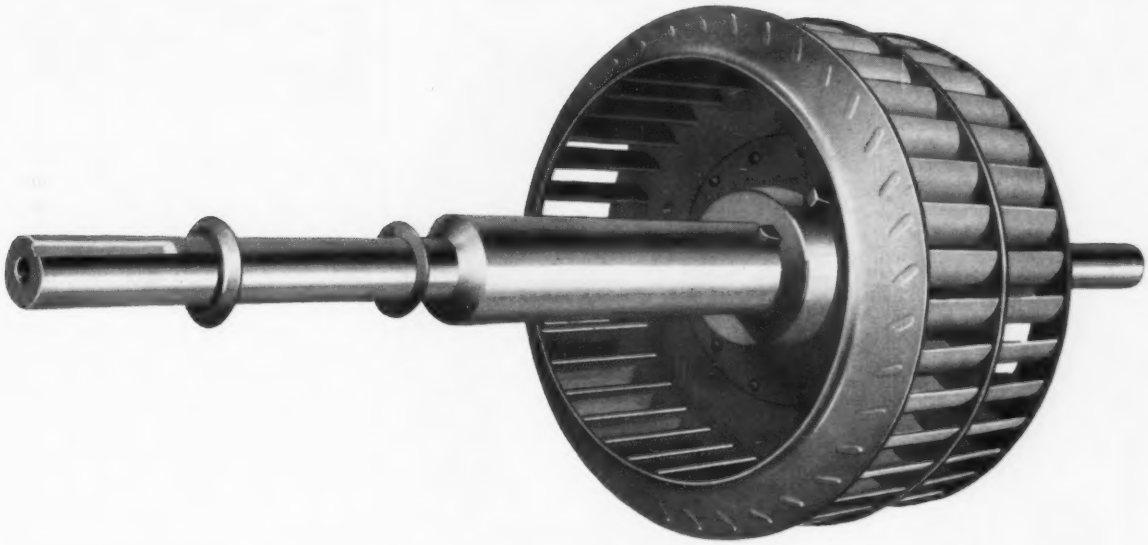
533 **Welding profit** is title of 8-p bulletin D761. Discusses dual controls, parallel power, use of two steady arcs. Caterpillar Tractor Company

534 **Stainless steel** welding guide is 20-p booklet in Q and A form. Arcos Corporation.

535 **Electrode** pocket guide ADC 650G contains 70 pp, includes consumption calculator in tabular form. Air Reduction Sales Company

For more facts circle 876 on Reader Service Card p 222

CLARAGE



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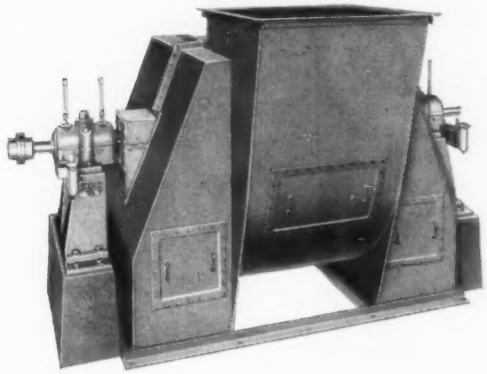
In the Clarage tradition of heavy-duty construction, here is induced draft equipment offering numerous advantages:

36 radially deep, aerodynamically curved blades impart dynamic energy to the gas stream which is effectively directed to achieve low tip speed operation.



Unique shape of blades and rims minimizes shock losses and turbulence, helps extend high efficiency over wide performance range, assures low moment of inertia (WR^2).

Advanced design of wheel and housing reduces floor space and height requirements for low first cost, low installation cost.

Special design and rugged construction of the wheel assures long service life and low maintenance cost.

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Dependable equipment for making air your servant

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For more facts circle 877 on Reader Service Card p 222

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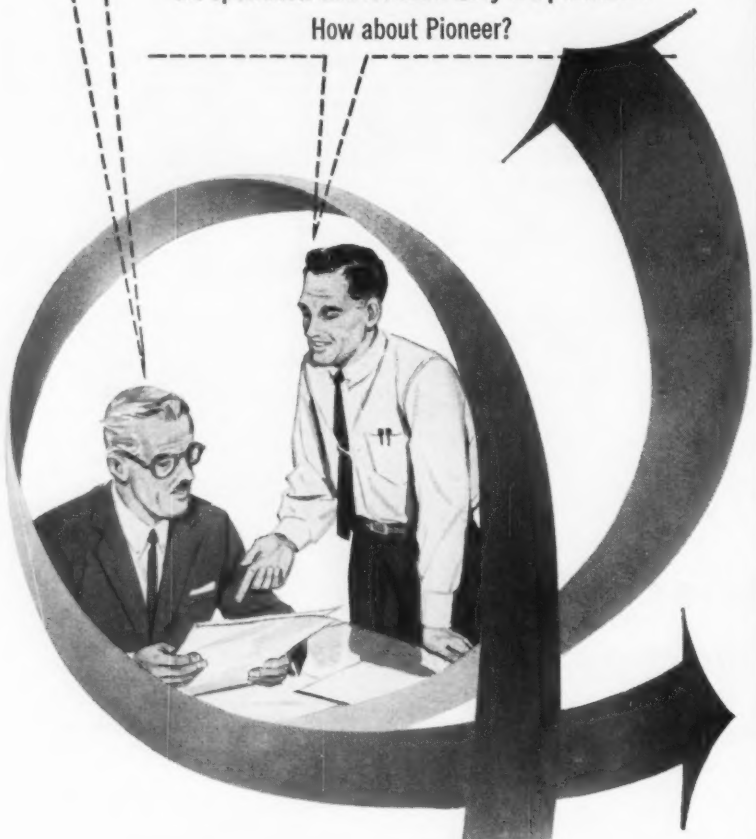
Your regular staff is overloaded now. Call in the specialists and let them carry the peak load. How about Pioneer?



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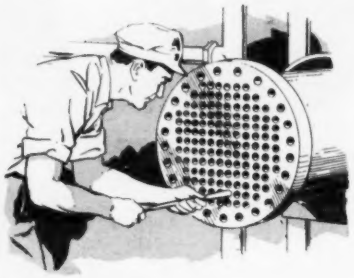
HEAT EXCHANGE



LATE HEAT-EXCHANGE EQUIPMENT: Circle key numbers on Reader Service Card, page 222, to get complete info

104 **Largest single-cell** air-cooled heat-exchanger ever built has total surface of 267,000 sq ft. It will be used as a hydrocarbon vapor condenser and cooler, cooling hydrocarbons from 475 to 195 F. When in service at Esso A. G. gasoline refinery, Cologne, Germany, 1,160,000 lb of air will pass through cooling sections. Selection of this unit for refinery service over conventional water-cooling system points up trend to air-cooling methods. — The Griscom-Russell Company

105 **Vapor condenser** uses principle of evaporative cooling with rejection outdoors of condensate heat. Vapors are condensed in two parallel-mounted water-sprayed coils enclosing central plenum under fan section. Air stream enters above coils, travels downward over them and enters plenum, where it drops entrained moisture and passes up and out through fan. Spray water is recirculated; only a small amount is consumed. Condensate drains into manifold where screening baffle tube separates noncondensables. These are cooled 7 to 8 F and ejected. — Niagara Blower Company

106 **Shell and tubular-coil** heat exchanger condenses 1 lb steam per minute up to 3500 psi at up to 1100 F. Condensate, at 80 F, is analyzed to determine mineral content of steam in electric generating stations operating at high pressures, temperatures.—Technical Engineering Products, Inc

107 **Surface condenser,** being installed at Commonwealth Edison Co's Dresden Nuclear Power Station, has 120,000 sq ft of condensing surface consisting of 16,530 tubes. It is of single-pass con-

struction with fabricated steel shell and hotwell and cast-iron divided waterboxes. Prime requirement of nuclear cycle is need for absolutely pure condensate. Therefore, to stop possibility of circulating water leaking into condensate, unit is equipped with dual tube sheets, with space between inner and outer tube sheets to be filled with pure condensate under pressure. They are expanded to form a tight joint where they pass through inner tube sheets. Any leakage into steam space at joints between inner tube sheets and tubes would consist only of pure condensate. Likewise, leakage at outer tube sheets would be noncontaminating since it would be outward leakage of condensate into the circulating water. A further precaution: hotwell is divided into four longitudinal sections to aid in localizing any condensate contamination.—Worthington Corp

108 **Direct-fired unit** heats transfer oils, other liquids. Oils may be circulated through coils, molds, jacketed vessels and other heat-exchange equipment. Forced internal-circulation design of heater provides high-velocity flow of heat-transfer oil over heating surfaces. Uniform oil temperature eliminates hot spots, coking or deterioration of the oil.—Cleaver-Brooks Company

109 **Pre-engineered exchanger** comes in 1-, 2- and 4-pass designs, with 1.2 to 124 sq ft of heat-transfer surface. Unit tackles process heating jobs and cooling of lube oil, jacket water, hydraulic and other fluids. Features reported are: baffle structure with flanged lip at each tube hole and around outer edge for tighter tube fit and improved thermal characteristics; stamped steel feet movable in three positions; corrosion-resistant copper-alloy core assembly.—Ross Heat Exchanger Div, American-Standard

110 **Small-sized exchanger** copes with pressures to 5000 psig, temperatures to 1200 F. Shell and tubular-coil unit is applicable to feedwater heaters, hot-water softeners, h-p and l-p boilers in nuclear and conventional power plants. Unit is housed in stainless-steel shell 3½ in. in dia, 11¼-in. long. Sample pipe and circulating

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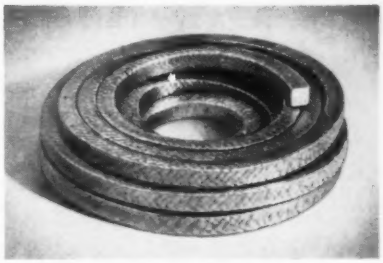
Style No. 30 – For use against petroleum products at high temperatures and pressures. A very dense packing, made by braiding jackets of asbestos yarn over a center core of pure asbestos content. The jacket is treated with a special heat-resistant compound. The outer jacket is lubricated with a coating of graphite.



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For more facts circle 879 on Reader Service Card p 222

water connections are made externally to avoid possibility of sample contamination from leaky joints, fittings. — The Carpenter Steel Company

111 **Custom-designed** and standard high-capacity heat-transfer line is reported to operate under reduced pressure with a high degree of heat exchange for heating, cooling. Units operate as (1) oil and fuel coolers (2) air-to-air, liquid-to-liquid, liquid-to-air and saturated-vapor-to-air exchangers (3) evaporators and condensers for compartment cooling. — Tenney Engineering, Inc

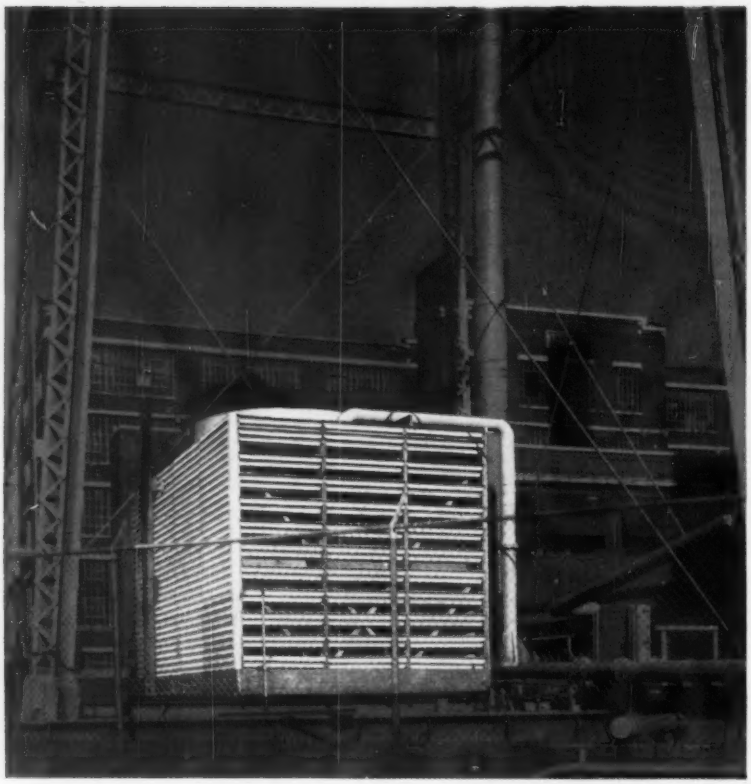
112 **Small, rotary** air-to-air heat exchanger can take waste gas at 1000 F, handle flows of 250 cfm or, in parallel setups, of over 2600 cfm. Chief component of the 20-in. dia, 11-in. deep unit is the rotor made up of individual sector-shaped baskets containing the heating element.—Air Preheater Corporation

113 **Desuperheater** for close control of reduced steam temperatures, regardless of load variations, features weighted steel ball for controlling orifice opening. Vaporization is so complete that reduced steam can be held constant only 20-ft downstream from desuperheater outlet.—Copes Vulcan Div, Blaw-Knox Company

114 **Cupro-nickel, 30%** heat-exchanger tubes reportedly combine excellent corrosion-resistant properties with favorable mechanical properties. Recent installations include exchangers at Dow Chemical Co's Freeport, Texas plant and Tidewater Oil Co's Delaware refinery. — Scovill Manufacturing Company

115 **Heating coils** designed for process application are made in prime-surface and extended-surface types. Metals include: aluminum; copper; stainless, carbon and alloy steels; hot-dipped galvanized steel. Pressures to 3000 psi are available in many types of coils. —Niagara Blower Company

116 **Low-cost panel coils** provide efficient heat transfer, are easily removed and replaced. Reactor fitted with these units allows relatively large volume within tank, plus a large heating and cooling surface.—Dean Products, Inc



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MARLEY **The Marley Company**

Kansas City, Missouri

For more facts circle 880 on Reader Service Card p 222

Begins on page 244

117 **Impervious graphite** heat-exchanger tube with internal low fins is reported to more than double inner surface area of shell and tube exchangers. The 23 fins, each 3/16-in. high, increase inner surface to 2.6 times that of a plain 7/8-in. ID tube.—National Carbon Company

HEAT-EXCHANGE BULLETINS: To get your free copies, circle key numbers on Reader Service Card provided on p 222

536 **Heat-transfer systems,** high-temperature units, are subject of 12-p bulletin 200. American Hydrotherm Corporation

537 **Heat exchangers** are topic of 16-p catalog. Diagrams thermal standards and reference data. Condenser Service & Engineering Co

538 **Type BCF exchangers** are described, illustrated in 8-p bulletin 1.1K6. Contains spec sheets on 46 sizes. Ross Heat Exchanger Div, American-Standard

539 **Compact heat exchanger** is detailed in 12-p bulletin. Contains flow diagrams, schematics. Air Preheater Corporation

540 **Surface condenser** bulletin M-571 has 4 pp of design, technical data. Southwestern Engineering Co

541 **Heat exchanger costs** are compiled in fast-reading booklet. Wolverine Tube Div, Calumet & Hecla Inc

542 **Condensers,** low-level eductor and multi-jet types, are discussed in 8-p bulletin 5AB. Units are for condensing steam under vacuum at ground level. Schutte and Koerting Company

543 **Condenser tube** and tube-sheet material selection, application, installation are covered in 44-p manual. Includes 12 spec tables. The American Brass Company

544 **Steam coils,** double-tube type, are discussed in 8-p bulletin B-1418. Gives specs, installation drawings, piping diagrams. American Blower Div, American-Standard

545 **Heating coils** for heavy-duty steam service are subject of 12-p bulletin 1715. Sturtevant Div, Westinghouse Electric Corp

546 **Cooling coils** are described in 50-p illustrated bulletin 880. Includes construction and dimensional data, surface charts, circuiting diagrams. American Air Filter Company, Inc

547 **Stainless steel** tubing for heat exchangers and condensers is topic of 4-p bulletin TB415. The Babcock & Wilcox Company

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An extra switch on the No. 150 provides circuits for cutting off burner and sounding low water alarm—a final safeguard from emergency conditions such as current interruption in the pump circuit or failure of make-up supply.

Ask for engineering data covering all conditions. For boilers up to 250 psi. ask about the new 92 Series Pump Control.

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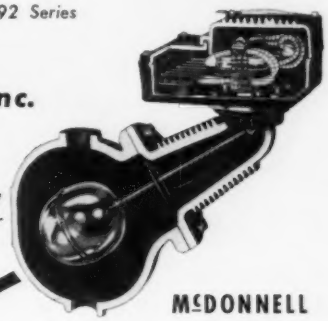
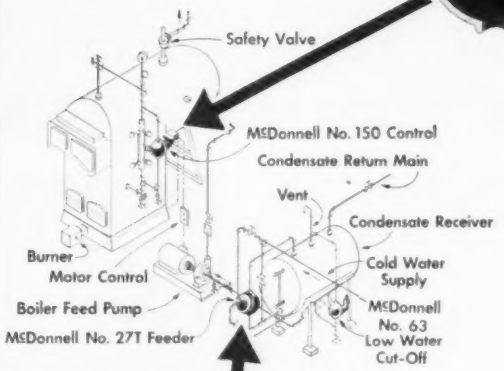
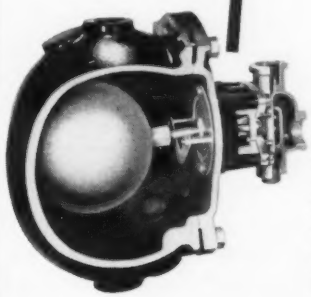




McDONNELL No. 150 PUMP CONTROL

The most widely used, time proved control of its type—for boilers up to 150 psi. Underwriters' Listed. Has two mercury switches—one for controlling feed pump and one for low water cut-off and alarm. Packless construction features heavy monel sylphon. Switch leads have porcelain bead insulation. Also available with water column type body—No. 157.



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Has large water feeding capacity which permits locating the No. 27T at a relatively low point on the receiving tank; this provides adequate space for return condensate, preventing wasteful overflow. Sturdy construction withstands turbulence in receiver. For tank pressures to 35 lbs., water supply pressures to 100 lbs. McDonnell Make-up Feeders also include flange-mounted types.

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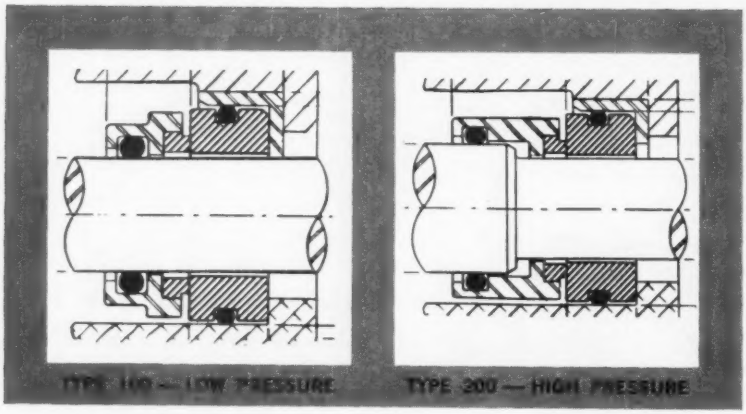

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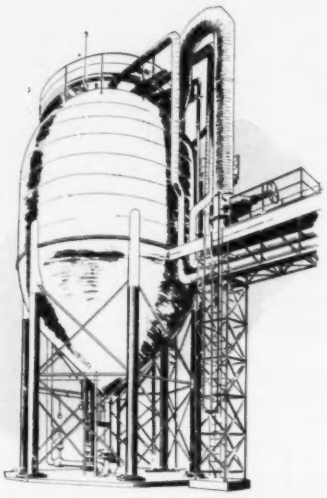


Water treatment is a rapidly changing segment of the power field. Chemical side is marked by introduction and increased use of coagulating aids. Hydrazine continues its upswing in popularity as an oxygen scavenger. More algicides and slimicides are being used to control organic fouling in circulating cooling-water systems that have cooling towers. New ion-exchange resins are offered with generally improved stability, better resistance to organic fouling.

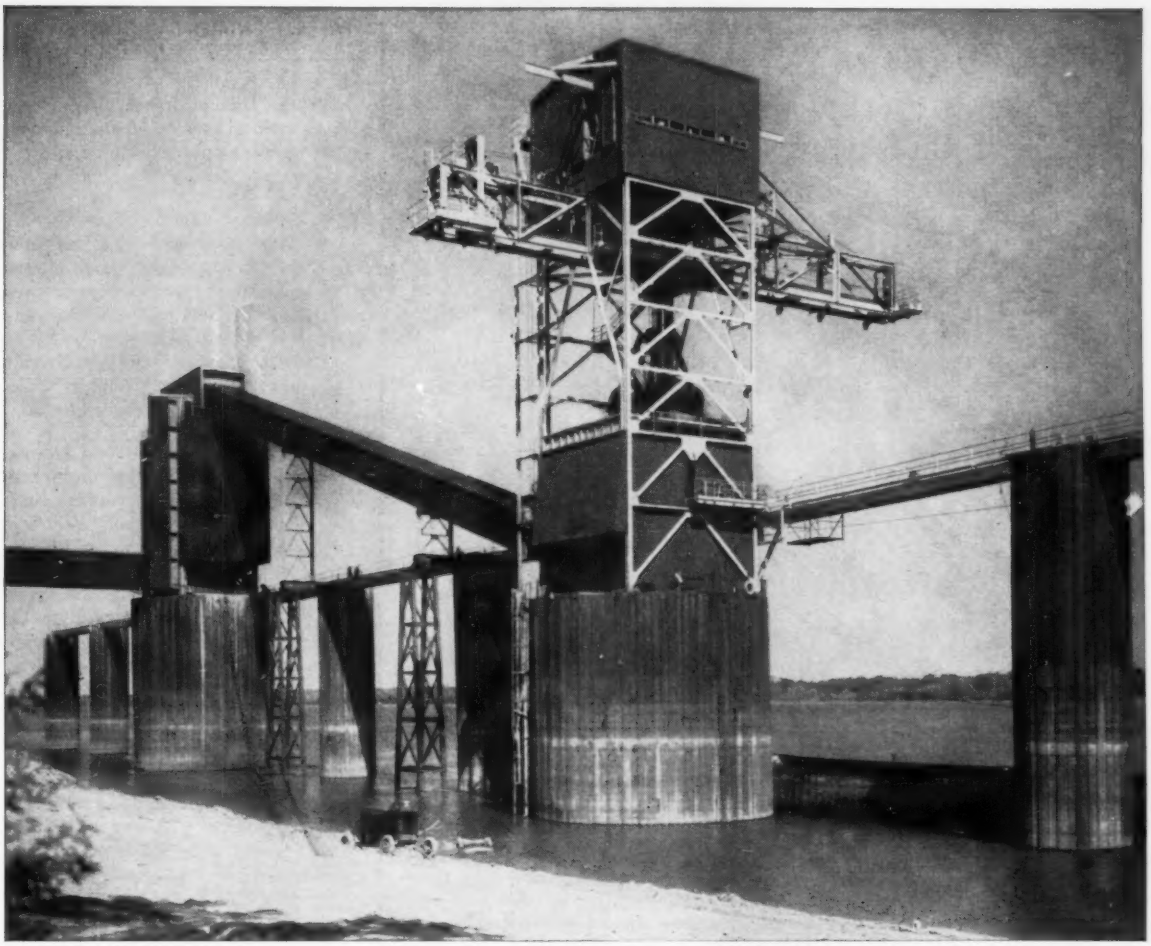
Equipment design accent is on automation, more efficient operation. Demineralizing equipment still plays a major role in water treatment for h-p boilers, nuclear power reactors. Water recovery and reuse is coming more and more into the picture as a vital part of every plant's overall water-treatment system.

R H Marks

Assistant Editor

WATER-TREATMENT EQUIPMENT and PRODUCTS: Circle key numbers on Reader Service Card provided on page 222 to get the complete product story

118 **New trend** and a departure from previous treatment standards are condensate scavenging demineralizers. Formerly, makeup alone was demineralized, with only chemicals used to treat condensate. This isn't true for today's supercritical boilers. Result: At Cleveland Electric Illuminating Co's Avon Station, they're installing Cochrane mixed-bed demineralizers for condensate scaveng-



9-ton coal unloader, with free digging capacity of 850 tons per hour, has an average operating lift of 75 feet and travel distance of 40 feet.

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Dravo experience in the design and construction of complete bulk materials handling installations can help you lower coal handling costs materially. Take the facility shown above. The cellular steel sheet pile dock requires no maintenance, provides safe mooring for barges and supports the barge shifters, other auxiliaries and the unloading tower.

This all-welded tower has a single hoist motor and drum which perform all hoisting and lowering operations. Hoisting rope pull is equalized, and a counterweight reduces hoisting horsepower. A separate drive provides independent and positive bucket closing.

Dravo facilities provide for the design, fabrication and erection of the complete job. Tower, dock and auxiliaries are integrated into a smooth-running installation designed to operate at maximum efficiency and low cost.

Dravo heavy materials handling equipment is at work in power plants, steel mills, port docks and other materials transfer points. You can learn about Dravo's complete line of trolleys, bridges, towers and other related equipment by writing for Bulletin #225. Better still, let us arrange for your visit to actual installations. Simply call us at Pittsburgh, Spalding 1-1200, or write DRAVO CORPORATION, PITTSBURGH 25, PENNSYLVANIA.

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Rotojet Junior Tube Cleaners are unusually powerful for their size and weight. They are fed easily through the tubes with the operating hose, and can be shifted quickly from tube to tube. Their convenient size, speed, and ease of operation offer a marked contrast with external cleaners costing many times more.

An air valve directly behind the Rotojet motor permits one-man operation. Very little headroom is required, and either vertical or horizontal tubes can be cleaned.

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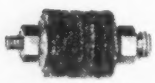

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Air valve for one-man operation.

ROTOJET® Junior TUBE CLEANERS

ELLIOTT COMPANY – ROTO PLANT
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Begins on page 248

ing. This equipment is also reported to have decided advantages for h-p plants below critical pressure.—Cochrane Corporation

119 **Packaged demineralizers** feature plastic columns for carbon filter and ion exchanger. Operating on mixed-bed principles, units produce to 100 gph of tasteless odor-free water. Exchange capacity of resin charge is 18,000 gr. Overall dimensions are 15x15x86 in.—Penfield Manufacturing Company

120 **New monitoring system** checks, indicates malfunction in operation of automatic demineralizing plants. It provides an "electrical shadow" that follows cycle control sequences and operation of automatic valves and auxiliaries. If malfunction occurs, impulse from "feedback" is received which indicates and locates problem. Unit can sound an alarm, shut down the plant or both.—Graver Water Conditioning Co

121 **Diatomite water filter** is reported to reduce bacteria, remove visible sediment and organic matter, produce water of zero turbidity. Slurry-fed unit uses synthetic cloth-covered filter plates that hang from roller carriages for easy inspection and removal.—Sparkler Manufacturing Co

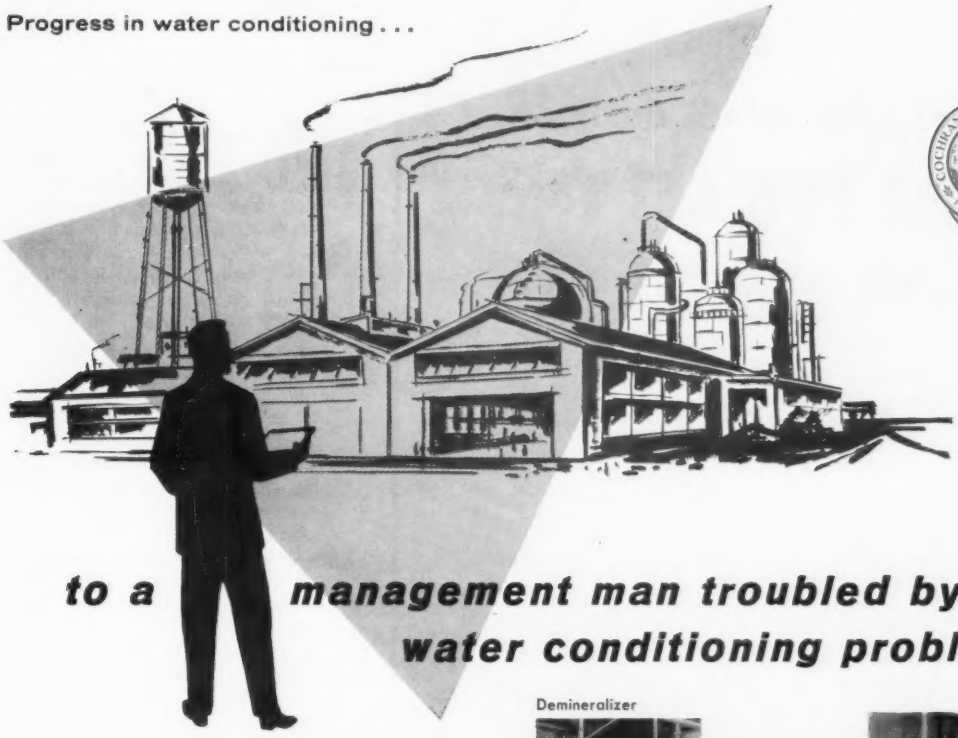
122 **Completely portable** battery-operated electrolytic conductivity recorder is used for stream salinity and pollution surveys, well logging, many in-plant applications. Instrument is direct reading in micromhos, can be supplied in wide variety of ranges. Size is 13⅞-in. high, 11⅝-in. wide, 9½-in. deep; weight is 18 lb without batteries. Unit is housed in gasketed, splashproof, drawn-aluminum case.—Industrial Instruments Inc

123 **Anion bed support** eliminates need for subfill media, cuts final anion unit rinse requirements. Lower internals, similar to those in mixed-bed demineralizers, incorporate unique corrosion-resistant bed support medium that allows passage of water in either direction while retaining the resin. Bed support also provides for uniform collection and distribution over the entire cross-sectional area of the support.—Graver Water Conditioning Co

(*Continued on page* 252)

For more facts circle 884 on Reader Service Card p 222

Progress in water conditioning . . .



to a management man troubled by water conditioning problems . . .

Is your plant's water treatment system overloaded by new boilers, turbines or process equipment? Can your product be improved or made more uniform by higher quality water? Sometimes the only answer is to install a complete new system, but in many industrial plants Cochrane has been able to find far less costly solutions utilizing present equipment.

Cochrane is in a unique position to assist your staff in analyzing all approaches to your problem and selecting the most economical one. Its experience in water and heat engineering covers nearly a century and every industry from steel to pharmaceuticals and atomic power. Cochrane manufactures all types of water treatment equipment, assuring you of an unbiased recommendation. A Cochrane representative will be glad to discuss your problem with you or your staff. There is no obligation, simply call or write: Water Treatment Division.

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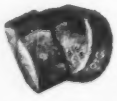

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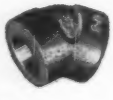
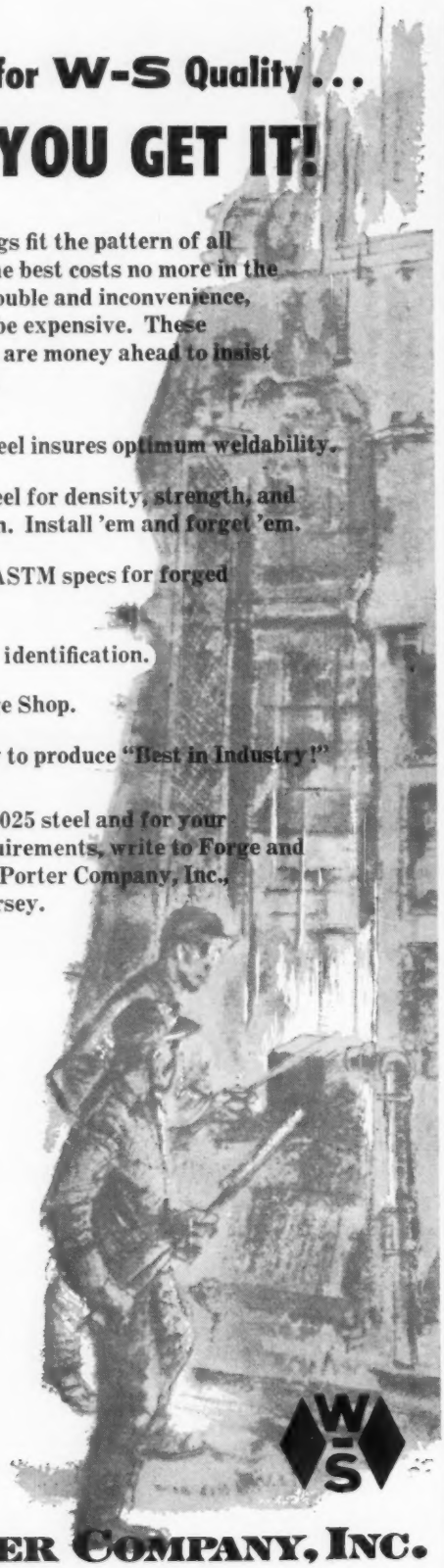


FINISHED FITTING



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WATER TREATMENT

Begins on page 248

124 **Solids contact reactor** is designed for coagulation and lime softening at cold-water temperatures of raw water, either for process purposes or as pre-treatment ahead of boiler feedwater-treatment plants. Units combine mixing zone at the bottom with clarifying zone above. Bottom agitator in mixing zone keeps old precipitates in constant supension, assures thorough mixing and contact between old and new precipitates. Result: a more complete reaction with a minimum of chemical requirements and retention time.—Cochrane Corporation

125 **Complete pH package**, designed for multi-station use, includes five portable instruments with carrying cases and buffer solutions, two buffer kits, two extra probes and two sets of batteries.—Analytical Measurements, Inc

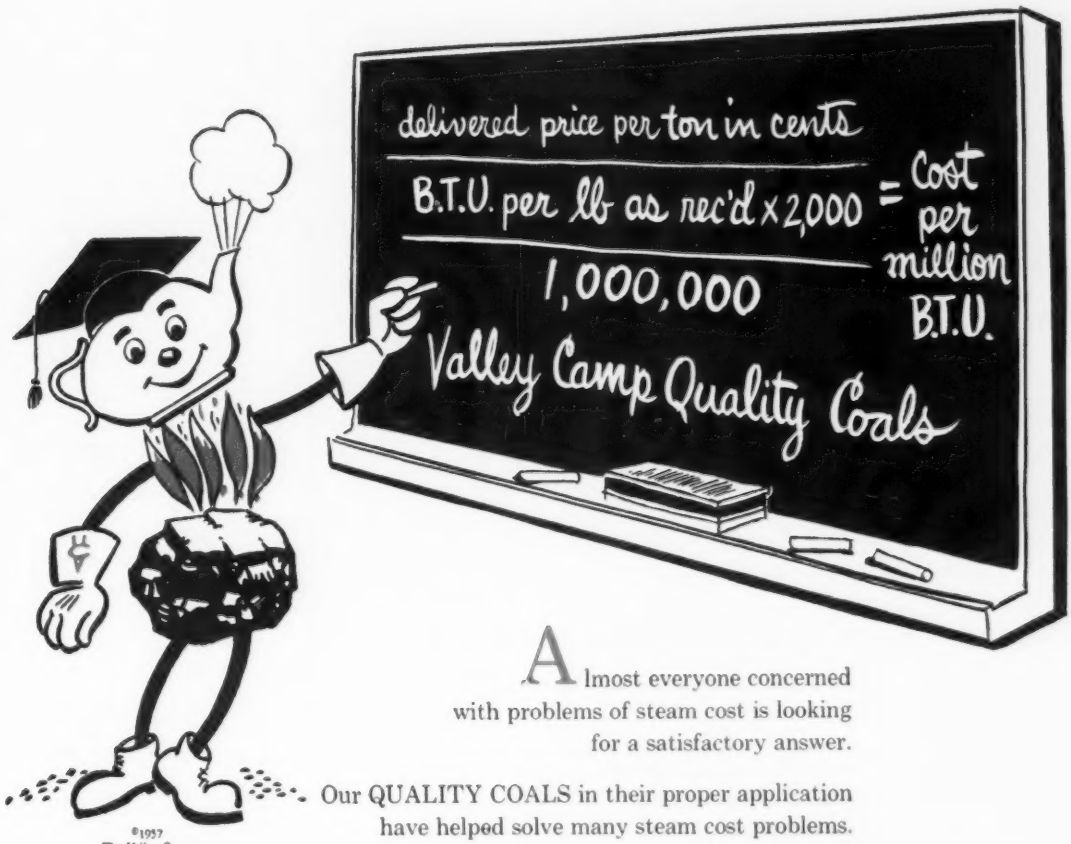
126 **Chlorine analyzer** gives continuous measurement of free, combined or total residual chlorine in water or sewage. Essentially a double light-beam filter photometer, it's accurate to within ± 1% of maximum range. Use of split beam is reported to eliminate effect of color or turbidity.—Fischer & Porter Company

127 **Cation-exchange resin** is reported to resist breakage, minimize pressure drop in ion-exchange units. Almost colorless beads are free of internal stress and strain. Operating temperatures to 250 F do not affect stability or capacity, thus resin is particularly suited for use in hot-lime zeolite water-treating plants.—National Aluminate Corporation

128 **Colorimetric analyzer** is used for detecting solids in feedwater for h-p once-through boilers. Every step of analysis from flushing sample cells to recording results are performed automatically. Available with one to six pens for multiple recording, analyzer uses single light source for uniform intensity in comparing sample to blank or standard sample. Analysis takes 3 to 12 min, depending on application. In ranges of 0 to 50 parts per billion for dissolved silica and 0 to 30 parts per billion for dissolved oxygen, accuracies are within ± 2%.—Milton Roy Company

(*Continued on page* 254)

let Mr. BTU HELP solve Your steam cost problems



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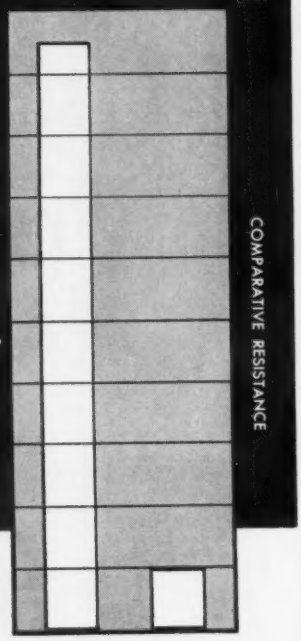
IT'S NO MIRACLE...

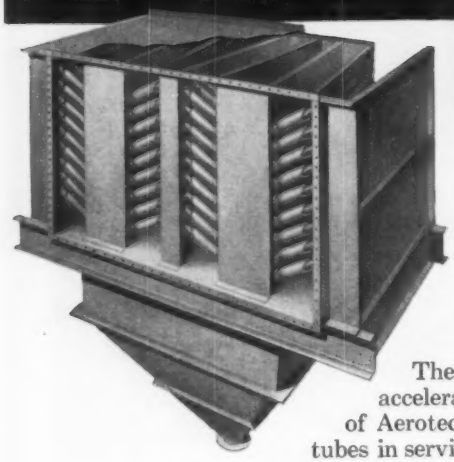
THAT

AEROTEC

WHITE CAST IRON CENTRIFUGAL TUBES OUTLAST ANY OTHER MATERIAL AND ARE *GUARANTEED*



Bar chart shows comparative resistance of white iron vs. gray iron during identical accelerated abrasion tests.



The results of hundreds of accelerated tests and thousands of Aerotec 5RWS white cast iron tubes in service prove the wear resistant superiority of this metal.

And here are some other important advantages:

1. Five inch diameter tubes . . . provide maximum efficiency.
2. Compact configuration with inclined tubes in vertical tube sheets . . . requires minimum space.
3. Easy installation . . . preassembled blocks reduce chances of leakage due to faulty installation.
4. And especially designed inlet-outlet envelopes provide more even gas distribution.

Aerotec engineers are specialists in the problems of dust control. Why not contact our Project Engineers for more details?

Ask about the Guarantee!

Project Engineers

THE THERMIX CORPORATION

Greenwich, Conn.

(Offices in 38 principal cities)

Canadian Affiliates: T. C. CHOWN, LIMITED, Montreal

Manufacturers

THE AEROTEC CORPORATION

Greenwich, Conn.

WATER TREATMENT

Begins on page 248

129 **Ion-exchange resin** is recommended for treatment of all waters containing high molecular-weight organic compounds. Since resin beads are porous, they absorb large molecules readily, release them quickly during regeneration. Capacity is to 30.5 kgr per cu ft, as $CaCO_3$.—Rohm & Haas Co

130 **Steam analyzer** combines temperature control at atmospheric boiling point and hydrogen-exchange process with reboiling to provide efficient method of testing steam purity. Method minimizes interference from carbon dioxide, ammonia cyclohexylamine, morpholine. It gives simple temperature control, detects boiler-water carryover by continuous conductivity. —Industrial Instruments, Inc

131 **Overload control** is for use on company's Reactivator water clarification and softening unit. It's an hydraulic lifter on sludge scraper shaft of the Reactivator which goes into action when heavy sludge stops normal scraper rotation. Lifter raises scrapers as high as 12 in. or more—depending on volume of sludge—so they can remove top sludge layer and work down until entire bottom area has been cleared and scrapers can run smoothly in their normal position. Device is an economical answer to a problem common to slurry clarifiers.—Graver Water Conditioning Co

LATE WATER-TREATMENT BULLETINS:
To get your free copies, circle key numbers on Reader Service Card, p 222

548 **Hot-water softeners** are subject of 24-p bulletin that describes equipment, illustrates tank designs. Cochrane Corporation

549 **Zeolite** water softening units are treated in 6-p bulletin 28B7107A. Allis-Chalmers Manufacturing Co

550 **Demineralizers** are discussed in 8-p technical bulletin 108-A. L-A Water Softener Company

551 **Water softeners,** mixed-bed and multi-column deionizers are subject of 20-p bulletin 611C. Elgin Softener Corporation

552 **Chlorinator** with manual or automatic control is described in 8-p bulletin 25-130. Includes design features, flow diagram, technical data. Wallace & Tiernan, Inc

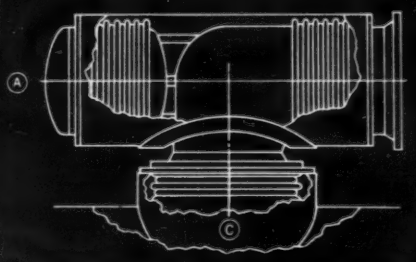
(*Continued on page* 256)

For more facts circle 888 on Reader Service Card p 222

circle 889 on Reader Service Card p 222 ➤

GIANT Turbine Expansion Joints Built by BADGER

Badger balanced elbow expansion assembly.



Joint A balances thrust due to internal pressure of 65-150 psi; joint B absorbs axial movement; joint C absorbs the differential expansion between the inner and outer casings of the turbine. Assemblies range in size from 36 to 42 inches in diameter.

Photo shows 150,000 kw steam turbine-generator unit undergoing tests prior to shipment at General Electric's Turbine-Generator Plant in Schenectady, N. Y. Badger Expansion Assembly is clearly visible atop turbine.

Custom engineered assemblies include many features of Badger S-R Design

750°F steam is flashed through these turbine crossovers at speeds up to 150 ft/sec and pressures up to 150 psi.

How do you protect piping and turbine casings from the stresses of extreme internal pressure and the expansion such temperature is bound to produce?

Working together, Badger and engineers at General Electric's Large Steam Turbine-Generator Department solved the problem with a new type pressure balanced elbow expansion assembly. Using two separate joints mounted in a T-shape casing (see diagram) the assembly effectively absorbs and controls axial movement. Although the device was custom engineered to General Electric's requirements, the bellows elements are constructed to the Curvilinear Corrugation design recently announced by Badger and now used in all S-R Expansion Joints.

Whether you need standard S-R Expansion Joints or custom equipment, Badger can serve your needs. Get more information — write for illustrated brochure today.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced . . . life increased.

Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer life.

Series 150 corrugation and ring cross-section

BADGER

S·R

SERVICE RATED

EXPANSION JOINTS

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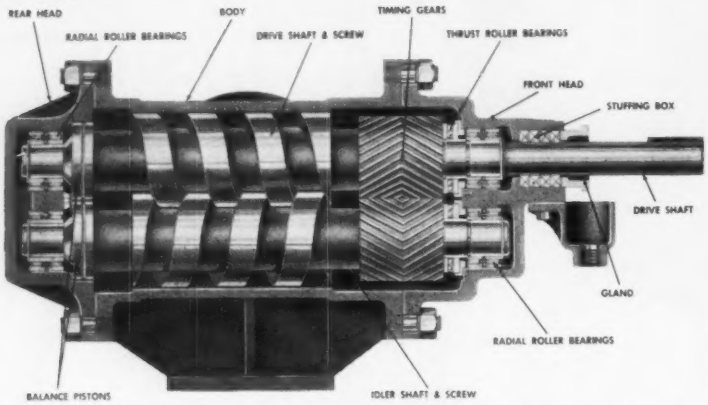
BADGER MANUFACTURING COMPANY
230 Bent St., Cambridge 41, Mass. • 60 East 42nd St., New York, New York
Representatives in Principal Cities

SIMPLICITY lowers the cost of this WARREN TWIN SCREW PUMP

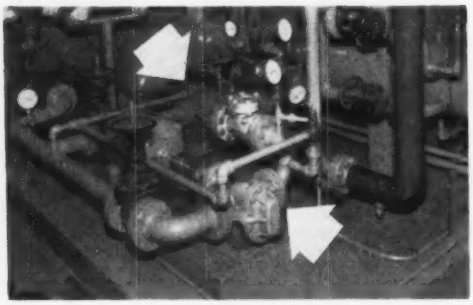


Here's an inside view of a high-speed screw pump that will do the work of other top quality rotary pumps costing twice as much!

Notice the simple construction of this Warren Twin Screw Pump, and the minimum number of parts. The compactness means low initial cost . . . and because no special foundation is needed, installation costs are minimized. No modification is required for vertical operation where floor space is extremely limited, or where the driver must be elevated to prevent flooding.

Maintenance of this efficient type TS pump is also economical. By removing the rear head only, rotating elements can be withdrawn *without disturbing the piping or motor,* and repair parts *that need no field machining* can be shipped immediately from stock.

Four sizes of type TS Screw Pumps are available for capacities to 550 GPM and discharge pressures to 350 PSI over a wide viscosity range. They are particularly suited for *fuel oil services* and other heavy duty oil services requiring a constant, pulseless flow. An ideal application is pictured below.



Two Warren Type 337TS Twin Screw Pumps on *fuel oil burner service* are shown in this installation at the Holyoke, Mass. Gas & Electric Department Plant.

WRITE FOR BULLETIN 255

for more detailed information about the TS Screw Pump that does the job for about one-half the cost.

WARREN

CENTRIFUGAL · SCREW · RECIPROCATING · ROTEX

WARREN PUMPS, INC.

WARREN, MASSACHUSETTS

P-37

Begins on page 248

553 **Water evaporators** are topic of 8-p bulletin. Gives capacities, flowsheets for vapor-compression apparatus, flash evaporators, centrifugal compression stills. Badger Manufacturing Company

554 **Antifoams** to control foaming and carryover in steam boilers are covered in 4-p bulletin HSP-905. Hagan Chemicals & Controls, Inc

555 **Sludge dispersant** and soot remover are subjects of 4-p folder. Western Chemical Company

556 **Internal** self-purification of feedwater and condensate is discussed in 8-p reprint T-157. Graver Water Conditioning Co

557 **Water purification** equipment is topic of 6-p bulletin. Lists deionizers, demineralizers, dealkalizers. H M Mueller Corp

558 **Water treatment** of wet type dust collectors is discussed in 2-p bulletin. The North American Mogul Products Company

559 **Basic refresher** on industrial and boiler feedwater is offered in 12-p booklet 4433. The Permutit Co

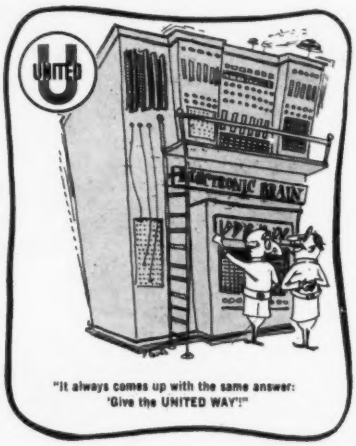
560 **Scale remover,** other products for use in evaporative condensers, cooling-tower systems are covered in 8-p bulletin. Calgon Co

561 **Case histories** on cooling-water treatment are given in bulletin 137. Betz Laboratories Inc

562 **Water analysis** procedure, test kits, apparatus and chemicals are covered in 48-p catalog 5. APHA standard methods are included. Hach Chemical Company

563 **Chemical feeder** automation is treated in 8-p bulletin BIF-P7. Omega Machine Company

564 **Phosphates** for boiler water conditioning are detailed in 4-p bulletin HSP-906. Hagan Chemicals & Controls, Inc



"It always comes up with the same answer: 'Give the UNITED WAY'!"

For more facts circle 890 on Reader Service Card p 222

Turbine in supercritical-pressure steam system uses

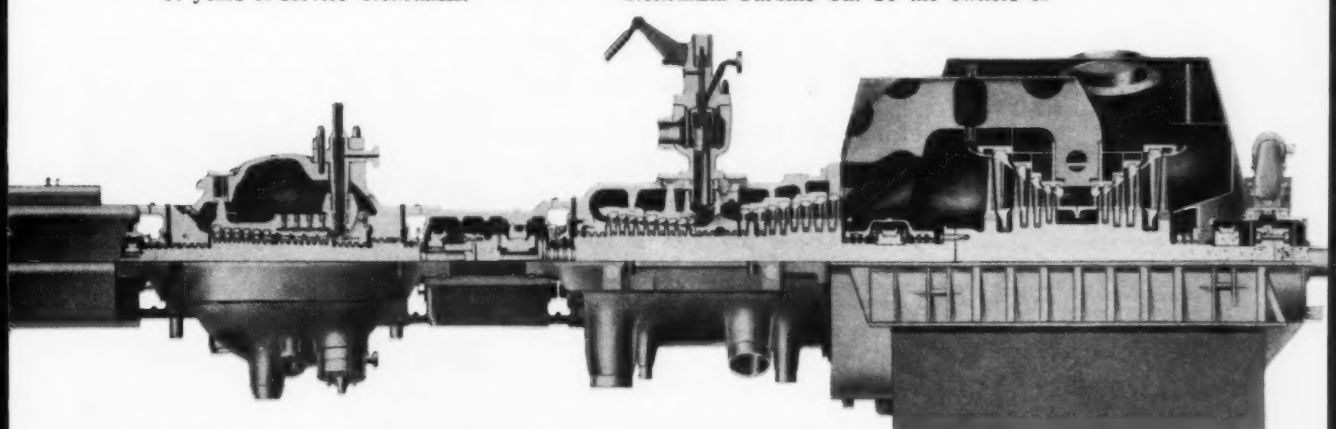
Nonpareil TURBINE OIL

. . . and
American Gas & Electric Power
receives
life-of-turbine guarantee for the oil

A General Electric turbine, for which the main steam pressure is 4,500 psi and the temperature is 1,150°F. has now been in service for more than a year. The performance of this developmental turbine, its associated steam generator and other equipment, indicates that this plant will set the pattern for steam power plants for the future. It is appropriate that the turbine oil is one that has been proved in more than 30 years of service—NONPAREIL.

To achieve new records in efficiency of operation and to accomplish even more efficient generation of electric power, American Electric Power engineering management had to be *sure* of every item of material used in the installation. NONPAREIL Turbine Oil was tested and found fully capable of providing the superior lubrication required by this history-making unit.

Over 1,000 turbines are in service using NONPAREIL Turbine Oil. To the owners of each of these turbines, a guarantee has been issued, which certifies that *for the life of the turbine* the oil will never exceed an acidity level of 0.15 mg. KOH/g. Most often it is in the order of 0.03 to 0.06 mg. KOH/g.



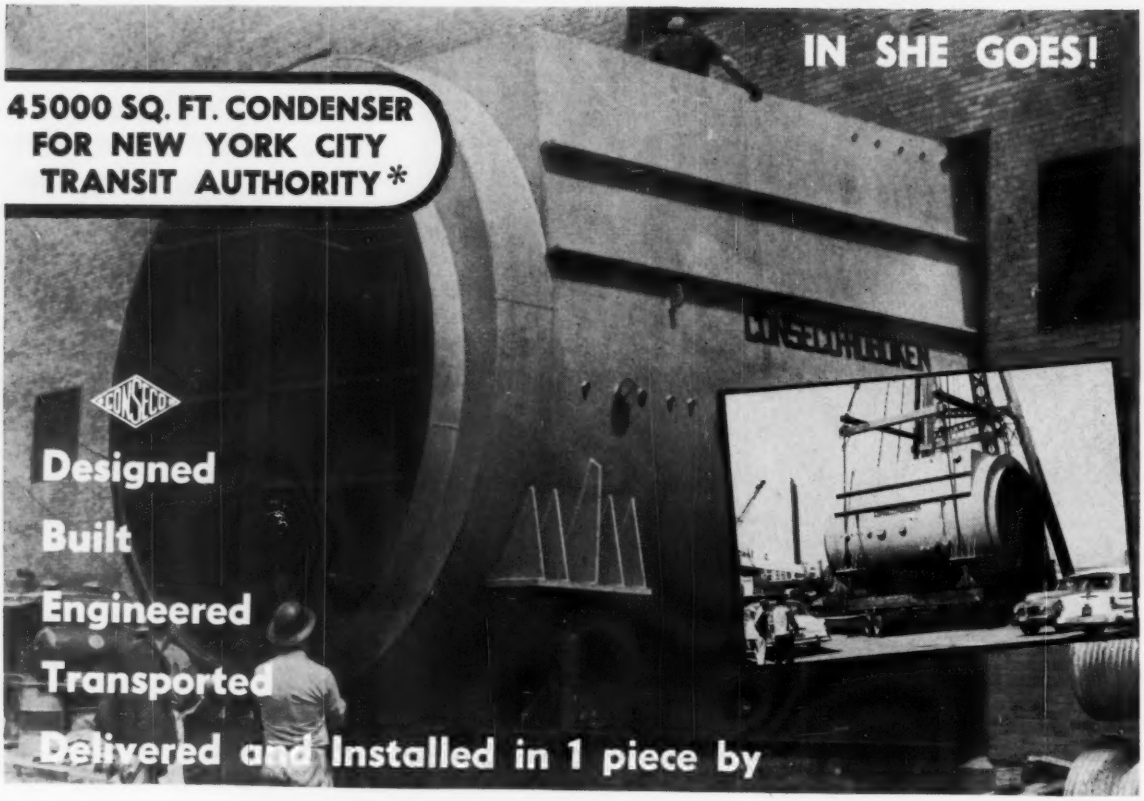
An industrial lubrication specialist in the Standard Oil office near you, in any of the 15 Midwest or Rocky Mountain states, will be glad to give you additional data on NONPAREIL Turbine Oil. Call him. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

Quick facts about
Nonpareil Turbine Oil

- Will not permit formation of harmful acids
- Will not permit formation of sludge or oil varnish
- Will maintain good demulsibility or water separating characteristics
- Has high resistance to foaming
- Contains adequate rust inhibitor

You expect more from STANDARD and get it!

For more facts circle 891 on Reader Service Card p 222



CONSECO

Previous unit furnished by another supplier installed in SEVEN pieces

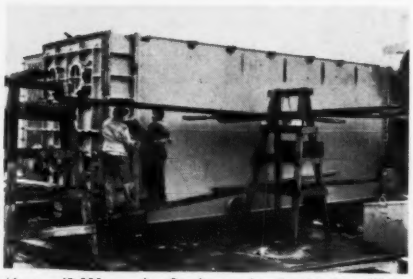
This job and others shown, prove that CONSECO has the facilities and experience for BIG fabrication of tubular equipment in their own shops.

What Condenser Service and Engineering will do for you is told in four words—"From Blueprint to Operation".

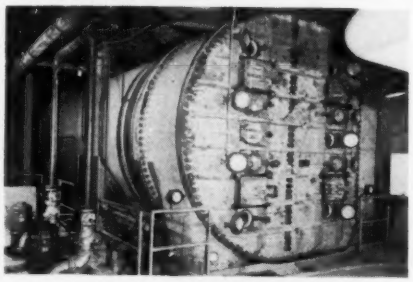
Condenser Service covers the design, fabrication, delivery, installation, supervision and maintenance of tubular equipment—a COMPLETE SERVICE—no matter how large or how small your job, no matter where located. It is the first choice of Engineers who have well-placed confidence in our more than 30 years of experienced engineering, sound design, dependable manufacturing and better performance.

*** Equipment Furnished By CONSECO Under This Contract**

- Main Condenser
- Steam Jet Air-Ejectors
- Hogging Ejector
- Circulating Pumps
- Condensate Pumps
- High Pressure Feedwater Heaters
- Low Pressure Feed Water Heaters
- Condensate Coolers
- Service Water Coolers
- Evaporator
- Deaerating Preheater
- Deaerating Heater
- Fuel Oil Heaters
- Boiler Feed Pumps
- Evaporator Feed Pumps
- Heater Drain Pumps
- Evaporator Drain Pumps
- Salt Water Circulating Pumps
- Cooling Water Circulating Pumps
- Fuel Oil Pumps
- Lighting Off Oil Pump
- Air Compressor for Ignition System
- Air Compressor for Instrument Air System
- Air Receivers
- Tanks
- Hydrostatic Test Pump

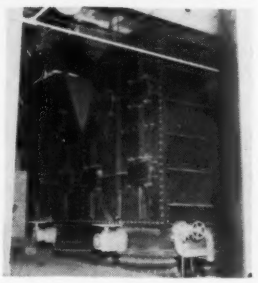


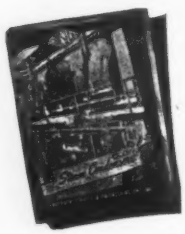
Above—45,000 sq. ft. Condenser for Puerto Rico Water Resources Authority.



Above — One of 3 — 70,000 sq. ft. Condensing Plants, Dept. of Water and Power, City of Los Angeles

Right—35,000 sq. ft. Condenser for Dairyland Power Cooperative, Alma, Wisconsin.





CONDENSER SERVICE AND ENGINEERING CO., INC.

164 Observer Highway, Hoboken, N. J.

Phone: OLdfield 9-4425 N. Y. Tel: BArclay 7-0600

Send For This Steam Condenser Bulletin

For more data consult Engineering Catalog pages 559-562

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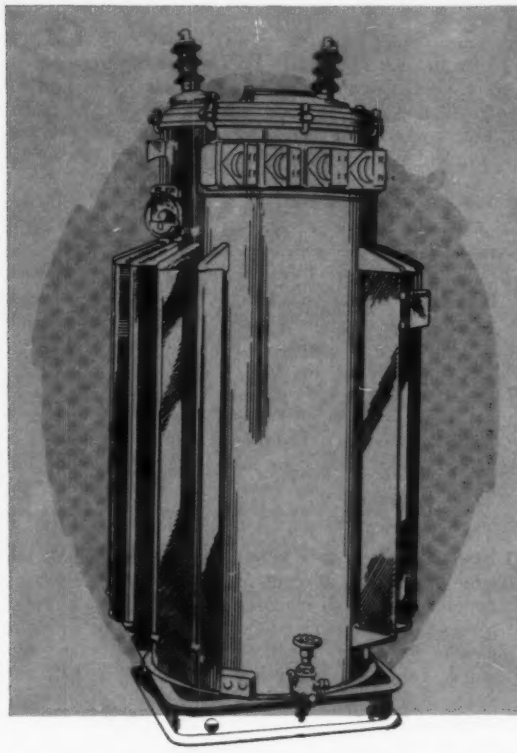
COMPLETE BULLETINS SENT ON REQUEST

For more facts circle 892 on Reader Service Card p 222



Water cooling by hollow conductors is making news in the extra-large generator field. It makes possible a big increase in winding capacity over cooling systems using oil or gas. On other end of size scale, increasing complexity of processes needs more specialty generators for high frequency, dc at unusual voltages or close voltage regulation, standby service, isolated locations, etc.

Under incentive to up ratings but keep sizes within bounds, transformer makers have come up with improved cooling designs, too. Inner cooling, where oil is circulated between strands of parallel conductors at the same potential, may prove to be a major advance. Attention has been given to tank pressure, and one company has marketed a unique pressure relief valve.

Silicon has gained popularity at expense of germanium as semiconductor rectifier interest continues at high pitch. Unit capacity has jumped, with increased ruggedness, interchangeability.

Norman Peach
Assistant Editor

Recent equipment developments: Circle key numbers on Reader Service Card, p 222, for more information

GENERATION

132 **No possibility of sparks** with these brushless ac generators: all spark-producing components have been eliminated, replaced with a system of rectifiers that changes part of ac output to dc. The dc is fed to field poles of the exciter, and ac output of this revolving-armature exciter goes to a rectifier assembly where it's changed to dc. Newly produced dc is then fed to generator's revolving-field poles. Units are offered in 50-, 60- 400-cycle models.—Kato Engineering Co

133 **"Packaged power" generator** boasts a completely static excitation and voltage-regulation system that helps make possible an almost maintenance-free operation. System has no moving parts, tubes, vibrating contacts or commutator brushes. Exciter consists of several rectifiers, a saturable reactor, resistors and wiring—all mounted in a dripproof enclosure. Unit is offered in 60-cycle ratings from 219 through 375 kva at 1800 rpm and 187½ kva through 250 kva at 1200 rpm.—General Electric Company

134 **Ninety seconds is starting time** of portable diesel-powered peaking and reserve plant with 6000-kw 4160-volt capacity. The "power block" is made up of three 2000-kw engine-generator units and a centralized control unit, each in a steel weatherproofed housing. It is designed to operate unattended, automatically supplying full load power into a utility system. Equipment is designed and arranged for minimum maintenance, is readily accessible for inspection and servicing.—Electromotive Div of General Motors Corporation

135 **Single-bearing 60-cycle generator line** is designed for adaptation to commercial gasoline and diesel engines. Design features include elimination of end ball bearing, with exciter armature being supported by main alternator bearing.—Kato Engineering Co

136 **Wind-driven power package** for remote, isolated areas, consists of a 6-kw wind generator, battery bank and standby diesel generator. Complete plant is mounted on 33-ft steel tower, can withstand wind velocities in excess of 100 mph. During long periods of low wind velocity, load is carried by batteries which are recharged by generator.—Nordberg Manufacturing Co

137 **Series of h-v motor-generator sets** offer motors to 200 hp, 4160 volts at 1200 rpm; generators to 300 kw, 4160 volts at 1200 rpm. Alternators are available in two-bearing single-unit construction, or in single- or two-bearing design for adaptation to commercial engines.—Kato Engineering Co

138 **Long-life lead-calcium batteries** for full float operation are triple insulated, designed for stationary use. Each cell in the new calcium battery has same capacity in a smaller size, saving 30 to 40% of floor space required.—Gould-National Batteries, Inc

TRANSFORMATION

139 **Ventilated dry type transformers** for industrial load center applications come with either forced-air cooling equipment or with natural circulation of air through openings at top and bottom of case. All safety requirements are easily met with the lightweight units: vaults and enclosures are unnecessary. Compact construction, absence of insulating liquids allow relocation when-

ever load demands change. Sizes range from smallest distribution transformer to forced-air-cooled units with 12,000-kva max.—Allis-Chalmers Manufacturing Co

140 **Development of "inner-cooled" transformer** represents major advance in design of power transformers. Using the new principle, transformers can be built smaller, lighter and in significantly higher ratings. Conventional units rated to 380 mva have been built; ratings to 600 mva are forecast. First commercial installation was at New York State Electric & Gas Corp. In the "inner-cooled" design, oil is circulated between the strands of parallel conductors that are at the same potential, eliminating oil ducts between coils and windings. This allows use of materials having higher insulation strength than oil where voltage stresses occur, so higher-capacity transformers having same design margins as conventional units can be built.—Westinghouse Electric Corporation

141 **Size and weight reductions,** better electrical characteristics result from redesign of network transformers. Heart of new units is spirally-laced core which brings to 3-phase network transformers the compactness and efficient use of magnetic steel that have until now been associated only with smaller pole type units. In the new transformers the core steel is preformed on mandrels, slit at every other turn and laced by hand through the three sets of high- and low-voltage coils. A 500-kva unit using the new design is only 53-in. high, compared with 70 in. for 1955 design of same rating.—General Electric Company

142 **Removable front panel** is feature of Class H dry transformer designed for lighting applications in circuits of 600 volts and less. Reported features are: exceptionally low exciting current; high temperature resistance; moisture resistance and chemical stability. Core and coil are elastically suspended for quiet operation.—R E Uptegraff Manufacturing Company

143 **Constant-pressure oil-preservation system** is offered on all power transformers above 10,000 kva. System is reported to eliminate oil-to-gas contact and wide pressure variations, helping to stop hazardous bubbles from developing in transformer oil. System feature is rubber air cell in expansion reservoir, located beside transformer cover.—General Electric Company

144 **Transformer molded of epoxy resins** is designed for indoor, outdoor metering applications. It can be used with watthour meters and in other applications where high accuracy at low burdens is required.—Standard Transformer Company

145 **Single-unit variable-voltage transformers** are suited for 10- to 250-kva service for line-voltage compensation, or as full-range control units with transformation ratings to 100 kva. Single- or 3-phase units operate on 240/480-volt input. Motorized voltage-control drive allows unit to be remotely controled if desired.—M & T Welding Products Corporation

146 **Line of h-v potential transformers** feature reduced cost, size, weight. A single core-and-coil unit with a single bushing, it is offered in voltage classes from 92 to 161 kv. Although smaller, lighter than previous designs, it meets all ASA standards for h-v metering, relaying.—Westinghouse Electric Corporation

147 **Sealed dry type transformers** are reported to save space, reduce maintenance work. They are available in sizes to 2500 kva and 15 kv. Because the transformers are 150-C rise units, no heat barriers are needed for installation near h-t working areas. They can be placed near workers without jeopardizing their safety; no fences, vaults needed.—Allis-Chalmers Manufacturing Co

148 **Network transformers** with corrugated tankwalls are offered as answer to high cost of installing and maintaining secondary network systems. Use of corrugated tankwalls is reported to cut size of vault required and, thus, lower cost of installation. Tank is easily cleaned, painted, and is reported to shed corrosive matter readily.—Moloney Electric Company

149 **Dry type power center needs less space** because of new setup of components and use of core and coils from the compact transformer. Centers are offered in 5- and 2.5-kv classes for high voltage; 600, 480, 240 and 120 volt for low voltage. Ratings, 3-phase, are 45 to 300 kva.—Westinghouse Electric Corporation

150 **New vault type power units** come in five standard kva sizes, from 112½ through 500 kva. They have proved popular with small manufacturers who have a heavy concentration of electrical load. Standard h-v rating is 4160Y; l-v ratings are 208Y/120, 240 delta and 480 delta. Compact all-in-one unit needs only half the space of a standard bank of single-phase distribution transformers.—Allis-Chalmers Manufacturing Co

151 **Unique safety valve** relieves mechanical pressure in oil-, gas- or askarel-filled transformers. Sudden or accumulated pressures no longer are a problem since valve opens at a predetermined point; cover reseals automatically at about 50% of relief pressure, and valve is ready to act again without any attention. The device is obtainable with a combination alarm switch and visible indicator arm, which can be reset with a hot stick from ground level. Air or water is prevented from entering during operation.—Pennsylvania Transformer Div, McGraw-Edison Company

CONVERSION

152 **Silicon rectifier assemblies** are rated at 100, 150, 200 and 300 kw for operation from various ac power supplies. They are provided as regulated or unregulated equipment and include, in a single enclosure, complete protective equipment, transformer and rectifier assembly. Regulated units also have a saturable reactor and voltage regulator. Because of inherent low-voltage drop of silicon cells, these assemblies operate at high efficiency—94 and 95% with regulated and unregulated assemblies, respectively. Other advantages reported: (1) long life (2) static equipment, except for motor-operated fan used for cooling the cells (3) completely self-contained.—Westinghouse Electric Corporation

153 **Heavy power conversion** in high ambient temperatures is feature of 23-kw silicon single-phase bridge rectifier. Designed for forced-air or natural-convection cooling, units consist of four silicon junctions mounted on a heat exchanger. Single-phase unit is rated at 50-amp rectified dc when convection cooled; 120-amp rectified dc when forced-air cooled at 1000 cfm. Hermetic sealing of individual junctions permits use in corrosive atmospheres.—International Rectifier Corporation

154 **Compact heavy-duty** 25-kw silicon rectifier power supply has dc output of 125-volt nominal at 200 amp, or 250-volt nominal at 100 amp. Designated S125-200, the 28x24x58-in. unit comes in a floor-standing cabinet. Ac input is 208, 230 or 460 volt, 60 cycle, 3 phase. The rectifier can be connected in series or parallel, or series and parallel, to provide dc voltage and current output required over single-cubicle output.—Perkin Engineering Corporation

155 **Up to 12 fin assemblies can be stacked** in series in germanium rectifier cooling tube. Result: a 20 to 25% higher cell rating for plating rectifier power supplies. Air-cooled design permits orientation of rectifier cell in tube assembly.—General Electric Company

156 **Rectifier junctions,** designed for application to heavy-duty electrochemical, metal-refining and similar installations requiring high current at low voltage, are reported to give 98.9% efficiency. Cast-aluminum housing removes heat from all-welded hermetically sealed junction at optimum rate. Unit comes in six types, with input voltages from 20- to 66-volt rms.—International Rectifier Corporation

157 **Transducer unit utilizes ac transformer** through which dc bus bar or cable is passed. Slipover feature avoids direct connections. Current ranges vary from 500 to 500,000 amp with a stated accuracy of .5 to 1%. Unit comes with isolation and ac transformers and a selenium rectifier.—Rapid Electric Company

158 **Mercury arc rectifier units** rated 1000 kw at 250-volts dc are powering a number of wire drawing machines at American Steel & Wire Division of United States Steel Corp's Cleveland plant. The two new units are of the sealed-tube metal-enclosed type, are equipped with associated ac and dc switchgear and a self-cooled ventilated, dry type rectifier transformer.—Allis-Chalmers Manufacturing Company

159 **Heavy-duty silicon rectifier** permits utilities to continue serving dc customers while installing ac power. Features reported are: (1) 98% efficiency at full load (2) 5% regulation with constant-line voltage (3) 4.5% ripple across outside legs (4) submersible construction, seam welded to withstand 7 psi. Dc output is 120/240 volt, 1000 amp, 3 wire; ac input is 208 volt, 3 phase, 60 cycle, 4 wire. Unit operates continuously in ambients of 50 C with standard-grade oil coolant.—Richardson-Allen Corporation

160 **Hermetically sealed silicon rectifying cells** provide dc to 35 amp and 22 amp, halfwave, respectively, with a maximum peak inverse voltage to 600 volts. Forward voltage drop to cell will not exceed 0.9 volts at a forward current of 10 amp in ambient of 25 to 35 C. Reverse leakage is 20-ma maximum at rated peak inverse volts and maximum temperatures. Maximum operating junction temperature is 190 C.—Westinghouse Electric Corporation

161 **Pumpless steel-tank rectifier,** with mercury vapor and rare-gas filling is particularly adaptable to needs of electrochemical industry, dc networks, electric traction. Advantages cited include nonaging electrode inlets, instantaneous starting at 100% load. Rare-gas filling prevents buildup of overvoltages on anodes, ending danger of arc back.—Secheron Works Co

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565 **Dry type transformers** are discussed in 20-p buyer's guide GEC-1600. Includes 60-cycle indoor or outdoor single- and 3-phase units. General Electric Co

566 **Duplex transformers** are topic of 8-p bulletin 1757. Details units from 2400 to 13,200 volts. McGraw-Edison Co

567 **Transformers**—power, unit substation, industrial application and instrument types—are discussed in 20-p bulletin 61B6186C. Allis-Chalmers Manufacturing Company

568 **RM transformers,** 501 to 5000 kva, are described in 32-p bulletin GEA-6108B. Gives electrical characteristics, mechanical features. General Electric Co

569 **Transformer engineering** is topic of 12-p bulletin 137. Treats four series of dry type distribution units. R E Uptegraff Manufacturing Company

570 **Substation transformers,** 112.5 through 3000 kva, indoor or outdoor types, are described in 12-p bulletin 5804-1A. I-T-E Circuit Breaker Company

571 **Synchronous generators,** engine-driven low-speed types, are covered in 8-p bulletin GEA-5299B. General Electric Co

572 **Synchronous generators** for hydroelectric power generation are described in 24-p brochure PB-2800-1. Has sections on stator and rotor construction. Elliott Company

573 **Storage batteries,** stationary type for emergency light and power use, are topic of 24-p bulletin 210. The Electric Storage Battery Company

574 **"Calcium stationary batteries** for full float applications" is title of 12-p reference and spec catalog GB1848. Gould-National Batteries, Inc.

575 **Batteries,** from theory to maintenance, are covered in 44-p bulletin GB1599A. Gould-National Batteries, Inc

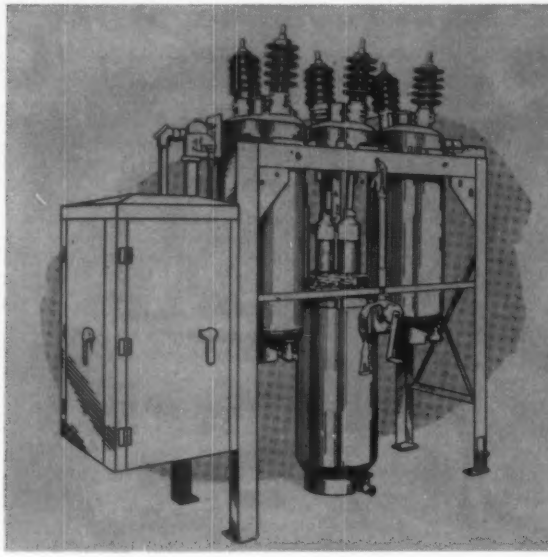
576 **Lead-calcium** grid batteries for control, switchgear, auxiliary power, other stationary applications are subject of 12-p bulletin CP-540. Covers units from 40 to 1650 amp-hr. C&D Batteries, Inc

577 **Lead-antimony** grid batteries are topic of 12-p bulletin CP-532. Covers design, construction of 10- to 1650-amp-hr units. Contains rack data, accessory details. C&D Batteries, Inc

578 **Battery racks** furnish topic for 12-p bulletin 70.00. The Electric Storage Battery Company

579 **Industrial batteries** for switchgear, alarm system, emergency lighting, are subject of bulletin GB1783. Describes 40 to 960 amp-hr units. Gould-National Batteries, Inc

580 **Converters, dc to ac,** are described in catalog 557. Contains performance charts, dimensions. Carter Motor Co



Electrical distribution methods keep accent on flexibility, labor savings. Makers of steel and aluminum trough and ladders have come up with improved lines, widened selection of fittings as result of field experience. Prefabricated busways are gaining favor, especially plug-in type.

How to protect growing loads with ever-bigger a-c interrupting needs is problem that spurred designers to fashion better lines of switchgear. And effort has been made to keep size down, ease servicing. Many new auxiliaries are featured in today's metalclad protective equipment. Gas-filled circuit breakers recently made their debut, but in giant sizes only. Research promises a wider range.

Norman Peach

Assistant Editor

Recent equipment developments: Circle key numbers on Reader Service Card, page 222, for additonal info

162 **New type of outdoor metalclad switchgear** provides a sheltered aisle for all-weather operation and maintenance. Aisle space is large enough for two breakers to pass side by side. Since new design eliminates front and rear doors and encloses a common operating aisle, it requires less plot area—up to 40% less—than conventional metalclad units. It's well-suited to double-row double-bus setup.—Westinghouse Electric Corp

163 **Indoor, outdoor 4.16-kv** horizontal drawout metalclad switchgear is designed for greater ease in installation, maintenance, operation. Chief feature is new "Ruptair" power circuit breaker with interrupting ratings of 75, 150, 250 and 350 mva. The new switchgear is 72-in. high, has eye-level instrumentation, shoulder height accessibility of auxiliary equipment.—Allis-Chalmers Manufacturing Company

164 **Improved weatherproofing and styling** are features of outdoor housings designed for electric utility and industrial metalclad switchgear applications. They can also be supplied for 1-v metal-enclosed switchgear, h-v contactor type motor starter assemblies and metalclad disconnect and interrupter switch units, in either outdoor type or "walk-in shelter" design.—Federal Pacific Electric Company

165 **Preassembled double-circuit substations** cut down on time required for erection, thus effecting a saving in field-assembly costs. Standard mounting setup of 1-v structure takes Power-to-Grow concept into account, permits replacement of transformer with larger unit in event of future load growth.—Moloney Electric Co

166 **Design change in stationary element** of 13.8-kv metalclad switchgear results in more positive and smoother action of protective shutter covering primary disconnect orfices. Linked to the breaker drawout mechanism, shutter automatically closes when breaker is withdrawn. When breaker is placed in the switchgear cubicle, it engages drawout mechanism and—as it is moved to the operating position—the shutter is raised to permit contact between the movable and stationary disconnects. Shutter now moves in roller bearing guides instead of metal tracks, insuring smooth operation.—Allis-Chalmers Manufacturing Company

167 **Color-coded tape** is designed for splicing and terminating either plastic or rubber cables. For connections under 2000 volts, it serves as both insulation and sheath. Features reported are optimum electrical characteristics; resistance to weather, chemicals, flames and mechanical abuse.—The Okonite Company

168 **Compact 10-amp relay** comes in 10-contact size, with a maximum of six normally open and four normally closed or eight normally open and two normally closed contacts. Unit measures 5-in. high, 3-in. wide—a valuable feature if panel space is limited.—Square D Co

169 **Low-cost 3-phase feeder voltage regulators** are rated 500 and 750 kva, 8660 volt and 500, 750 and 1000 kva, 13,200 volt. New design is reported to cut space 33%, weight 20% and cost 30%. — Allis-Chalmers Manufacturing Company

170 **Frame type dropout** is useful whenever a hole is to be cut through trough itself to a motor or distribution panel. Fitting bolted to trough bottom and rounded edges protect cable insulation. Comes in 6, 9, 12, 18 in. widths.—T J Cope Division Rome Cable Corporation

171 **High-voltage terminals** insulated with epoxy resin can now be made fast, accurately with method using predesigned terminal shields. These heavy-plastic units are cone shaped, of the interlocking "building-block" type. They are slipped over a plastic tube closed with a stepped end cap to fit various cable sizes. Each shield is rated at 5 kv, can be combined to 15 kv.—Minnesota Mining & Manufacturing Company

172 **Reinforced-phenolic wiring raceway** is reported to be self-extinguishing without after-glow. It's lightweight, durable, doesn't warp or sag.—Stahlin Brothers

173 **New compound in neoprene jacketing** has cut jacket's moisture-absorption rate in single-conductor power cables by 50%. Result: Jacket has greater tensile strength, aging, oil resistance.—General Electric Co

174 **Expanded-aluminum cable-support system** includes a wide range of standard fittings to provide flexibility, low installation cost, corrosion resistance. Trough is made with solid side; sections are fastened by flat pins driven between interlocking barrels.—T J Cope Division Rome Cable Corporation

175 **Plug-in busway,** rated 100 amp, 600-volt maximum, 3- and 4-wire construction, is used where outlets over a wide area are necessary. It can be hung on 10-ft centers in the edgewise position, and used as (1) a plug-in system (2) a feeder for lighting systems (3) a feeder or branch circuit from a switchboard or other power-consuming device. Variety of fittings and accessories can be used to tailor the busway to virtually any job requirement.—General Electric Company

176 **Aluminum cable-supporting ladder** reportedly offers lowest installed cost of any type cable supporting system. It is designed primarily for support of semi-rigid and armor jacketed cables. Major advantages: light weight, corrosion resistance.—T J Cope Division Rome Cable Corporation

177 **Nonsegregated phase bus** is completely sealed and insulated, may be used for generator leads to transformers, connecting transformers to switchgear assemblies, interconnecting switchgear assemblies and light distribution. Rated 4.16, 7.2 and 13.8 kv, 1200 to 3000 amp, unit has flexible or laminated connectors. —I-T-E Circuit Breaker Company

178 **Single-phase 10-kvar, 240-volt** secondary capacitor is contained in rectangular steel case with long-life zinc spray finish. A ground stud is welded to top of case. Weight is 56 lb; dimensions, not including terminals, are 13½x6x10 in.—Westinghouse Electric Corporation

179 **Pre-engineered low-voltage switchboard** is built in standardized modules for application versatility. It handles any incoming service, 600 volts or less. Structure and vertical bus bars are drilled to take virtually any combination of seven different low-voltage protective devices. Its mains are rated 800 through 4000 amp.—General Electric Company

180 **Size-8 ac clapper type contactor** augments line of Type 425 devices to provide heavy-duty contactors from 150 to 1350 amp. Compact, easily accessible, the contactor features ACBO arc interruption, self aligning bearings, mill-duty auxiliary interlocks. Dimensions: 39x19½x17⅝ in. — Allis-Chalmers Manufacturing Company

181 **Low-voltage capacitor equipment** for outdoor industrial applications is rated from 60 to 180 kvar, 230 volt; and 80 to 240 kvar, 460 and 575 volt, 60 cycle. Individually fused capacitors are assembled in weatherproof housing. Removable plate at base provides for incoming-line connections.—General Electric Company

182 **Combination under floor duct systems** are designed to meet demand for increased wiring capacity—especially for low tension service. Selection of eight junction boxes is available.—Walker Brothers

183 **Electrical ground detector and alarm** protects personnel and motors on 3-phase power systems. It can be set to discover line voltage drop of one volt in systems of any rating. Unit can be installed at any control point.—Principle Research & Development Co

184 **First gas-filled power circuit breakers**—115-kv 1000-mva units—are installed at Gulf Power Co's Pace substation, Pensacola, Fla., to obtain performance data. The breakers have a continuous current rating of 400-amp rms, will interrupt in 5 cycles and reclose in less than 15 cycles. Called the SF_6 breaker, it is restrike free, making it well-suited for switching capacitors, either single bank or bank against bank. The gas has good insulation properties and is used at relatively low pressure (45 psig).—Westinghouse Electric Corp

185 **Compactness is significant advantage** of JK and JKL molded-case circuit breakers. Providing continuous-current ratings of 225 and 400 amp and interrupting ratings of 25,000 amp at 600-volt ac, the breakers save one-third the space formerly required. Interchangeable thermal-magnetic trip units and front-removal lug design are features.—I-T-E Circuit Breaker Company

186 **Metalclad 13.8-kv air circuit breaker** of 1000-mva interrupting capacity protects distribution circuits in large metropolitan substations. Although unit has 35% greater interrupting capacity than the next lower rating of its type, it has same height and width, is only 4-in. deeper. Replacement or maintenance is simplified by horizontal drawout feature. Ceramic arc chutes are used.—Westinghouse Electric Corporation

187 **Extended-shaft handle operating units** are offered for all circuit-breaker frame sizes E through L. New line is reported to make it possible to mount breakers in enclosures from 5⅛ in. through 17⅛ in. deep, depending on breaker size and shaft length. Shafts can be cut to meet all depth requirements, and are designed to interlock with covers. Repositioning of shaft in socket permits upright or horizontal breaker mounting—General Electric Company

188 **Novel 6-pole anode breaker** permits drawout of individual poles without interruption of process power. Thus, there's a continued supply of dc power while one phase is being serviced. This feature cuts downtime on aluminum reduction and other electrochemical production processes where the high-speed anode breaker is used for fault protection of mercury arc rectifiers. Representing a complete redesign, the breaker is also reported to be lighter in weight, simpler in overall construction and smaller in floor space requirements than former models.—I-T-E Circuit Breaker Company

189 **Three-position breaker design** is feature of 600-volt, 15- to 4000-amp metal-enclosed switchgear. Interrupting ratings of the units are from 15,000 to 100,000 amp. With the circuit breaker in any of its three recognized positions—connected, test and disconnected—the breaker compartment door can be closed. Indication of breaker position is provided by two white lines on the mechanism.—Westinghouse Electric Corporation

190 **Metal-enclosed oil-cutout assembly** provides economic switching and protection of heavy industrial branch circuits. Assemblies are installed in parallel at plant's feeder line switch, one for every two branch circuits. Cutouts, single-phase or gang-operated 3-phase, are mounted on top of box. Feeder bus runs, connections and heater element to dispel moisture are completely encased.—General Electric Company

191 **L-v power circuit breakers** and switchgear equipment have been revamped for improved performance, simplified operation and servicing, greater standardization. The 600-volt breakers in 225-, 600- and 1600-amp frames are reported to be first to have quick-make feature for manual closure of breaker contacts. Units are 33% smaller, 55% lighter than old style. They have motor-driven stored-energy system for electric closure and easily interchangeable overload trips. Subassembly construction cuts parts replacement and servicing time. Reduction in breaker size permits four-high stacking of 600-amp breakers in standard 90-in. high enclosures.—I-T-E Circuit Breaker Company

192 **Heavy-duty momentary-contact switch** facilitates control of electric circuits in mobile equipment and where operator needs freedom of movement for better visibility or safety. Unit consists of pistol-grip handle installed at end of heavy-duty cable. It's rated at 10 amp, 125-volt ac at 0.80 pf. Action is momentary-contact double-pole single throw. Switch can be supplied with four conductor cables.—Electro Switch Corp

193 **Twin plug-in circuit breaker** makes it possible to install up to twice the number of circuits normally possible. Introduced at the same time is a line of circuit breaker load centers in main ratings from 40 to 200 amp and 2 to 40 branch circuits. Breaker is offered in ratings of 15 and 20 amp, and is suitable for use in protecting ac lighting and appliance branch circuits. Handle extensions are used to combine breakers for 2-pole operation.—General Electric Company

194 **Extra heavy-duty loadbreak cutout** is available in ratings of 5.2 and 7.8 kv, with fault interrupting capacity of 10,000 amp. Cutout's fuse tube is reported to be heavier and stronger than previous lower-rated models. Cutout also has double-vented feature, containing an expendable cap at the top, which melts when pressures inside are too high to escape through the regular aperture.—Westinghouse Electric Corporation

New free bulletins: To get your copies, circle key numbers on handy Reader Service Card provided on page 222

581 **L-v distribution** equipment and components are subject of 144-p general catalog. Has data on safety switches, disconnect and open-knife switches, circuit breakers, panelboards, busways. General Electric Company

582 **Power distribution** systems for 3- and 4-wire, 600-volt service are covered in 24-p bulletin 10. Gives info on feeder lengths, plugs. Electric Distribution Products, Inc

583 **Unit substation** technical library is title of 7-booklet set GET-2753. Details aspects of substation planning. General Electric Co

584 **Secondary unit subs,** from simple radial systems to secondary selective systems, are discussed in 20-p bulletin 18B6285C. Allis-Chalmers Manufacturing Co

585 **Substation structures** made of aluminum are described in 48-p bulletin. Gives design, cost data, ASCE specifications. Kaiser Aluminum & Chemical Sales, Inc

586 **Secondary substations**—complete, compact load distribution centers for either indoor or outdoor applications—are subject of 24-p bulletin 3104-1A. I-T-E Circuit Breaker Company

587 **Load centers,** circuit breakers, starters, panelboards, switchboards are detailed in 160-p catalog 141. Square D Company

588 **Power panelboard,** fusible type, is topic of 4-p bulletin GEC-1382A. General Electric Company

589 **Plug-in busway,** 225 to 1000 amp, is subject of 24-p booklet GEA-6173. General Electric Company

590 **Aluminum connections**—cable-to-cable, cable-to-lug, bus and tube, bus bar, bus tube types—are detailed in 32-p catalog AL45810M. Erico Products, Inc

591 **Aluminum conductors** are subject of 88-p catalog. Lists 4000 sag and tension charts for most types of covered and bare aluminum. Aluminum Company of America

592 **Connection techniques,** connectors, tooling is covered in 100-p manual. Gives principles of splicing, tapping, deadending. Includes charts, photos. Burndy Corp

593 **Stack-rack capacitor** equipments are topic of 8-p bulletin GEA-6796. General Electric Company

594 **Current-limiting fuses** are topic of 8-p bulletin GEA-6319B. General Electric Company

595 **Potheads** furnish subject matter for 12-p catalog 5703. Delta-Star Electric Div, H K Porter Co, Inc

596 **Insulated cables** of silicone rubber are discussed in 16-p bulletin. National Electric Products Corp

597 **Cable-support systems,** including troughs, ladders, channels, are covered in 60-p catalog. T J Cope Div, Rome Cable Corporation

598 **Electrical contacts** are discussed in 16-p catalog C-520. Includes data on silver, palladium, nickel contacts. Gibson Electric Co

599 **Automatic** transfer switches are detailed in 24-p bulletin. Automatic Switch Company

600 **L-v switchgear** is topic of 20-p bulletin 6004-C. Covers 225- to 4000-amp units. I-T-E Circuit Breaker Company

601 **"Protective relays"** is title of 16-p bulletin 5-020. Federal Pacific Electric Company

602 **Controls,** protective equipment make up contents of 152-p catalog digest. Contains specs, price list for switchgear, starters, etc. Square D Company

603 **L-v power** circuit breakers for circuits to 600-volts ac and 250-volt dc are detailed in 20-p bulletin GEA-5915D. General Electric Company

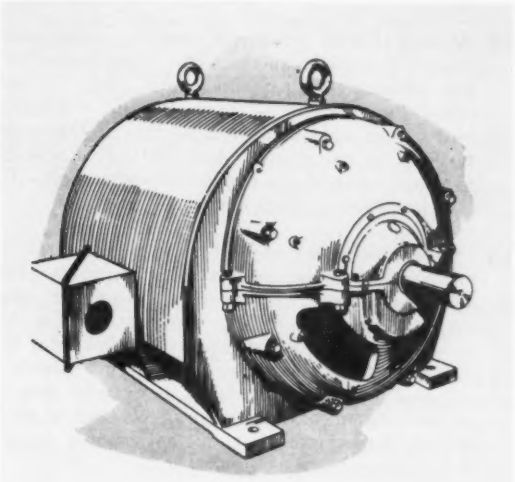
604 **Circuit breakers,** current-limiting types for l-v systems are topic of 20-p bulletin 5043A. I-T-E Circuit Breaker Company

605 **Voltage regulators** are discussed in illustrated 28-p bulletin 5.00.2. Electric Regulator Company

606 **Air circuit breakers,** switchgear products are subjects of 56-p catalog. Includes wiring diagrams. I-T-E Circuit Breaker Company

607 **Circuit breakers**—molded case, 15 to 800 amp—are described in 4-p bulletin GEA-6750. General Electric Company

608 **Butyl insulation** for wire and cable is analyzed in 28-p booklet. National Electric Products Corp



Motor manufacturers have come up with new frame designs to enable the plant engineer to get the enclosure best suited to his particular application. While doing this, they've also taken advantage of new, more rugged insulation to widen the range of application for standard open motors—thus simplifying selection, reducing number and variety of spares, and cutting costs.

Industrial processes continue to put more exacting demands on motor control; at the same time controllers must be less sensitive to voltage swings. Among innovations is a line of standard motor starters with overload relays in each of the three phases.

Norman Peach

Assistant Editor

New equipment designs: Circle key numbers on Reader Service Card, p 222, to get complete product story

195 **Just announced is new dc motor line** for rolling-mill application. Designer's aim: To make maintenance of the motors the easiest yet afforded operating personnel in the metal industry. Quick removable covers over both ends provide almost immediate access. And all cover bolts have been eliminated so cover can be removed in little more than the time it takes to attach the crane cable to the lifting eyes. New constant-pressure carbon brush-holders are standard for both reversing and nonreversing machines. Steel self-locking nuts and bolts are used to ward off loosening from vibration. Another maintenance-cutting design: upper motor is now located nearer mill, with extension shaft of lower motor passing under the upper unit. This puts both motors and thrust bearings in the open where they are easily accessible. Inspection lights and utility outlets are located inside the motor, providing a power source for hand tools. The motors, both 40 and 50 C, are forced ventilated, with Class B insulation throughout.—General Electric Company

196 **Forward strides in open motor application** are made possible by (1) all-silicone-rubber insulating system for form-wound stator coils in large motors and (2) epoxy-encapsulated coil structures for field windings of large synchronous motor rotors and for stators of smaller-frame motors with random or mush-wound coils. Both designs are incorporated in company's Super-Seal line of open motors, extending from 1 hp at 220 volts to 5500 hp at 4160 volts. Silicone-rubber insulation for coil windings is vulcanized into a solid dielectric wall without joints, voids or breaks. It is not bothered by humidity, thus dryouts are eliminated. Underwater tests of open motors with epoxy-encapsulated stators at full load are reported to have proved the structure impervious to moisture. Either insulation cuts need for protection in the frame construction.—Allis Chalmers Manufacturing Company

197 **New concept in design of large ac motors** permits the enclosure to be manufactured independent of the wound stator. Now, during assembly, the enclosure is bolted to motor's base—not welded or cast—making the wound stator fully accessible when required. Result: Company's full line of squirrel-cage, wound-rotor and synchronous motors from 250 to 7000 hp for all horizontal utility and industrial drive applications have been redesigned to use only six basic enclosures and 30 frame sizes as compared to the 450 frame sizes formerly used. Key advantages are: (1) Stator is readily accessible. (2) Protruding conduit box is eliminated. (3) Standardization is possible. (4) Accessories can be added without redesign of basic parts.—Westinghouse Electric Corporation

198 **Rain, wind, sleet or snow have no effect** on vertical all-weather motor designed to meet NEMA II Weather Protected specifications. Rated 250 to 2000 hp, it is constructed with either hollow or solid shaft, cooled by ventilated air taken from the surrounding atmosphere. To free this air of harmful moisture and dirt before it pierces motor's heart, it goes through three 90-deg direction changes, is lifted vertically through screens and expands in an air passage so velocity is reduced to less than 600 fpm.—The Louis Allis Co

199 **Motor designed for use under water** allows insulation system of its windings, bearings and magnetic components to be totally immersed. Major factor in its development was new insulation system using irradiated polyethylene. Motors of 250 and 350 hp are currently being produced for boiler circulation pump applications.—General Electric Company

200 **Engineered to take punishment** of adverse operating conditions is new weatherproof motor offered in all standard speeds, 1 through 250 hp. External parts of the open type motor are of corrosion-resistant cast iron. Shaft openings are sealed by a shaft cap and slinger. Insulation system can't absorb water, features silicone sleeving, glass-mica slot liners and glass mat top-sticks and mid-sticks. Watertight conduit box is cast iron.—Reliance Electric and Engineering Co

201 **Dc spindle motor, power unit and control,** to power a new series of 3-dimensional profile milling machines, was recently unveiled at Ekstrom-Carlson's Rockford, Ill. plant. The 50 to 6000-rpm machine is the first dc motor of shell type design. It's rated 10 hp, intermittent service at a base speed of 1500 rpm; delivers

constant torque from 50 to 1500 rpm and constant hp from 1500 to 6000 rpm. Class B insulation and liquid cooling are used to permit compact design and to keep weight of the totally enclosed unit to a minimum. —Allis Chalmers Manufacturing Company

202 **Straight-up ventilation is feature of** induction-motor line. This design means motors can be installed side by side for boiler-feed pump service without interchanging ventilating air. Units draw air in at bottom, expel it straight up. A second feature: low-noise-level operation.—Electric Machinery Manufacturing Co

203 **Rugged, compact enclosed motor** meets NEMA ratings to 50 hp, uses 46% less space than previous models. External parts are of cast iron, including split type outlet box. Two-way ventilation is provided for uniform cooling.—U.S. Electrical Motors Inc

204 **Designed for submerged operation,** motor can be close-coupled to agitators or pumps in sewage sumps, chemical, water and abrasive industrial oil applications. Motor shaft is directly connected to impeller. Single-phase and polyphase models are rated ¾ through 40 hp.—The Louis Allis Co

205 **Weight reduction to 25%** are reported for all-aluminum alloy frame motors rated ½ through 40 hp. Dripproof or totally enclosed fan-cooled models come in NEMA frame sizes 182 through 326U.—Reuland Electric Company

206 **Improved gasket designs** for enclosed motors provide a more effective seal against entry of foreign materials and moisture. All standard enclosed motors have a cork-neoprene gasket between the conduit box and frame. Smaller lead holes in the gasket are reported to give tighter sealing. Severe-duty motors will be equipped with a gasket design made of pure neoprene with formed sleeves that grip leads tightly to seal out corrosive materials, water and fine abrasive dusts.—General Electric Company

207 **Redesigned motors in 1- to 100-hp ratings** are built in same NEMA frame size as standard motors of equal hp. They reportedly accelerate as induction motors, but run at exact synchronous speed without permanent magnets or dc excitation involving collector rings and brushes. They can be used to provide precise frequency systems in small generator ratings, and come in any enclosure type — foot or flange mounted.—The Louis Allis Co

208 **Tube type squirrel-cage motors** are offered in polyphase ratings through 500 hp. Efficient cooling is provided by a series of tubes through which outside air is forced by an external blower. An internal blower at each end of rotor circulates warm air inside motor through ducts in the rotor and stator and around cooling tubes, to hold temperature rise within the specified limit. Motor frames are fabricated steel. Standard enclosed units are built with Class A insulation for 55 C rise or with Class B insulation for 75 C rise. Explosionproof designs have Class A insulation only and are UL approved for operation under classified hazardous conditions. Motors can be supplied with labels for Class I, Group C and D or Class II, Group E, F and G locations.—Wagner Electric Corporation

209 **Mechanical brake motors** are reported to reduce maintenance through design simplicity, elimination of coils and solenoids, and long brake life. They are well-suited for precision stopping, braking overhauling loads, or as a holding or hoist brake. Motors are available in polyphase designs 1800, 1200 and 900 rpm, plus some slower and multispeed models.—The Cleveland Electric Motor Company

210 **Packaged adjustable-speed drive** integrates an ac motor, a dc motor and semiconductor rectifiers. They afford continuously variable-speed control over speed ranges of 1½:1, 2:1 or 3:1. Maximum speed is 1690 rpm. All power requirements are supplied from normal ac distribution systems. Presently available in ratings 7½ to 125 hp or higher, they can be designed to serve either constant torque or constant-hp applications. Lower ratings are in the planning stage.—Westinghouse Electric Corporation

211 **Compact static power components** replace the conventional m-g set in new line of adjustable-speed dc packaged drives. Thus, all bearings, brushes, commutators, shafts and couplings are eliminated with a consequent reduction in installation and maintenance costs. Compact size makes possible savings to 50% in floor area, and weight reduction permits wall mounting of many sizes. The packaged units are available as either a 1- to 40-hp electronic adjustable-speed drive, or as a 1- to 200-hp magnetic-amplifier adjustable-speed drive.—Cutler-Hammer, Inc

212 **Weight reductions to 33%** permit easier installation of close-coupled pump motors, both standards and specials. The 7½- to 100-hp motors are designed to accommodate pumps built to the new, recommended NEMA Standards. They have solid cast rotors with no bolted or welded parts to loosen or vibrate, cast-iron frames and numbered leads for quick identification. Labyrinth seal on both sides of housing keeps grease in, dirt out.—General Electric Company

213 **All controls for 3-phase ac systems** at 220 volts, 1 to 100 hp, and 600 volts, 1 to 200 hp, are centralized in one group of stationary interchangeable enclosures, each with a grouping of modular starter units. The control centers are 90⅜-in. high, 20-in. wide and may be combined in straight-line, L- or U-shaped assemblies. They are available for front or back-to-back mounting of controls in NEMA-1 indoor or NEMA-3 outdoor weather-resistant enclosures. Each has main horizontal 3-phase bus, and 3-phase vertical bus for power distribution.—Westinghouse Electric Corp

214 **Compact, front-accessible motor starters** tackle full or reduced voltage starting jobs, reversing or non-reversing, dynamic braking or multi-speed control of squirrel-cage, synchronous or wound-rotor motors. They are available with either air break or oil-immersed contactors to 1500 hp at 2300 volts or 3000 hp at 4600 volts. Short-circuit protection of 150,000 kva at 2300 volts and 250,000 kva at 4160 or 4600 volts is provided by current-limiting fuses.—Allis-Chalmers Manufacturing Company

215 **Integral-horsepower manual starters** in NEMA sizes 0 and 1 are for control of motors to 7½ hp. Design features heavy-duty toggle-action operating mechanism

for positive opening and closing of contacts with no dead-center position. Rated to 600-volt ac or 250-volt dc, the starters are available in either 2-, 3- or 4-pole construction.—Square D Company

216 **Motor burnouts caused by single phasing** are eliminated by compact motor control utilizing 3-coil overload relays. Available for all sizes of 3-phase motors, in standard starter constructions and enclosures, they require no more space than starters with only 2-coil overload relays.—Cutler-Hammer, Inc

217 **Automatic inertia switch** is actuated by thrusts, impacts or excessive vibrations, provides full-time protection for unattended industrial equipment. Switch senses trouble and shuts off machine or sounds an alarm. Manual reset button or electrical reset may be used. Electrical rating is 1-amp 6-volt dc. Contact setup is single-pole, normally closed.—Micro Switch, Division of Minneapolis-Honeywell Regulator Company

218 **Selector switch with self-wiping contacts** will work in any electrical installation requiring heavy-duty controls. Switch has no buttons or dials; built-in self-wiping feature is reported to give long life, positive contact at all times. Models come with 4 to 10 contacts.—Sel-Set Machinery Corporation

219 **Push-to-test pilot light** has regular pilot-light features, plus separate circuit to test bulb. Pushing on color cap provides positive contact "feel" when unit is in test position. Light is oiltight in normal and depressed positions. There are no wires; all internal connections are pressure type, made of silver-plated beryllium copper.—Square D Company

220 **Heavy-duty control switch** is recommended for master switch service in steel mills, processing plants, copper, brass and aluminum mills. Features include a heavy-duty return spring easily accessible from rear of switch; bearings of case-hardened beryllium copper plated with nickel. They are arranged for pulpit, benchboard, switchgear or control cabinet mounting.—Allis-Chalmers Manufacturing Company

221 **Electronic fish control** is designed to electrically guide fish to predetermined areas, such as fish ladders, elevators and traps, and away from tail races. Control unit operates without moving parts, and adjustments can be made on the panel to compensate for water velocity, conductivity and size of fish. Other models prevent fish from entering hydro plants, industrial pumping installations, condensing-water intakes.—Electric Fish Screen Company

222 **First transistorized high-frequency systems** for lighting will bow in shortly. They are expected to eliminate present technical obstacles of indoor and outdoor use of high-frequency lighting, and to be competitive in price with present-day high-frequency systems. Prototypes in use supply power at 1500 cycles to 64 standard 40-watt rapid-start fluorescent lamps. First commercial units will probably be essentially the same as prototypes.—Westinghouse Electric Corporation

New electrical application bulletins: Circle key numbers on Reader Service Card, p 222, to get your copies

609 **Ac motors,** 1 to 125 hp, are discussed in 4-p bulletin B2506. Describes totally protected units, modifications. Reliance Electric & Engineering Company

610 **Synchronous motors,** high-speed models to 1500 hp, are described in illustrated 8-p bulletin GEA-6620. General Electric Company

611 **Induction motors** in the 150- to 1250-hp range are subject of 16-p illustrated bulletin 1950. Includes cutaways. The Louis Allis Co

612 **Motor application** guide is a 12-p booklet concerned with selection of 1/20- to 400-hp motors. Century Electric Company

613 **Tube type motors** with capsule-mounted split-sleeve bearings are covered in 8-p bulletin 51B8991. Describes machines from 40 hp at 600 rpm to 800 hp at 3000 rpm. Contains photos, diagrams. Allis-Chalmers Manufacturing Co

614 **Synchronous** induction motor is topic of 8-p bulletin 1900. Gives design data. The Louis Allis Co

615 **Wound rotor motors,** 5 through 150 hp with ac adjustable varying speed, are covered in 4-p bulletin GEA-6713. General Electric Co

616 **"High-frequency equipment"** is title of 12-p bulletin 2250. Details induction frequency converters for 80- to 400-cps application, and motor-alternators for 400 to 3000 cps. The Louis Allis Co

617 **Starting methods** for various synchronous motors are detailed in 10-p bulletin GER-1520. General Electric Company

618 **Motor starter** and contactor bulletin 14B8615 contains data on starters in 4.5 and 6 NEMA sizes; 50 to 400 hp. Allis-Chalmers Manufacturing Company

619 **Motor control centers,** NEMA sizes 1 through 6 starter units, are detailed in 12-p bulletin GEA-4979D. General Electric Company

620 **Magnetic components** are listed in 24-p bulletin. Contains info on transformers, chokes, saturable reactors, magnetic amplifiers. Varo Manufacturing Company

621 **Electric controls,** all-purpose types, are discussed in 12-p bulletin 106. Assembly Products, Inc

622 **Housings,** weatherproof and explosionproof models, are detailed in 16-p bulletin B158. The Adalet Manufacturing Company

623 **Controls** for electric equipment are subject of 88-p catalog GEC-1260C. Selection charts cover starters through 200 hp; product descriptions are given of contactors, relays, solenoids, limit switches. General Electric Co

624 **Basic switches** for industrial and commercial applications are discussed, illustrated in 32-p catalog 62C. Micro Switch, a Division of Minneapolis-Honeywell Regulator Company

625 **Adjustable speed** drives powered from in-plant ac circuits are detailed in 16-p bulletin D-2506. Contains photos, diagrams. Reliance Electric & Engineering Co

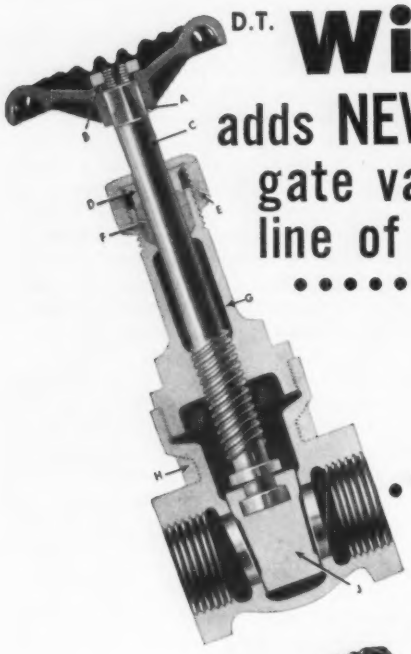
626 **Mercury floodlights** supply text for 8-p bulletin GEC-1486. General Electric Company

627 **Industrial lighting** is covered in 8-p reflector lamp and 24-p incandescent-lighting booklet. Includes full specs. Sylvania Electric Products Inc

628 **Electric fish screen**—modern way to keep fish out of industrial pumping installations, waterworks, hydro plants—is topic of descriptive data sheet. Electric Fish Screen Company

D.T. **Williams**

adds NEW SOLID DISC gate valves to the line of Quality Valves



A Hand Wheel
B Wheel Nut
C Bronze Stem
D Gland
E Bronze Packing Nut
F Asbestos Packing
G Bronze Bonnet
H Bronze Body
J Solid Disc

BRONZE FED-STAN® GATE VALVES—The new Bronze Fed-Stan Gate Valves are of the rising stem type and built expressly for steam, water, oil or gas service. These new valves feature bronze taper wedge solid disc and integral seat, screwed bonnet and inside screw rising stem. Like all Williams valves, they have been designed to withstand distortion, pipe and pressure strains. Screw end valves are available in 125 lb. (Fig. 1253) and 150 lb. (Fig. 1254) W.S.P. The valves are built to Federal standards as the Fed-Stan trademark would indicate.

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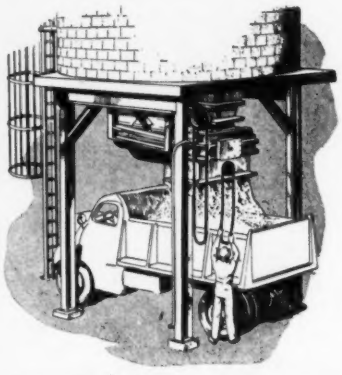
MATERIALS HANDLING and



NEW EQUIPMENT DEVELOPMENTS: Circle key numbers on Reader Service Card, p 222, to get complete details

223 **Pulsating panels** when spotted at strategic points in bins and bunkers offer a safe way to move stubborn bulk materials. Panels inflate, deflate at predetermined frequency and amplitude. They consist of rectangular steel plate covered with elastic neoprene diaphragm. Lying flat against one side of plate, diaphragm is wrapped around edges of plate and bonded to it on the back. Unit is bolted to inside of new or existing bin or bunker. Air is alternately admitted to and exhausted from space between steel plate and neoprene diaphragm, causing diaphragm to inflate and deflate rapidly. Neoprene is thick and tough enough to withstand severe abrasive service, has high resistance to attack by corrosive materials such as coal. PneuBin units operate to 150 F, are suitable for pyramidal, conical or cylindrical bins and hoppers, in industrial and utility power plants. —Gerotor May Corporation

224 **Slurry feeder** is capable of handling up to 20% concentration of diatomaceous earth on a continuous basis. Feeder is completely packaged, consisting of reservoir, pumping unit, integral air compressor for slurry agitation and electric motor with belt drive, all mounted in free-standing pedestal.—Wallace & Tiernan Inc

225 **Wobbler feeder** is a materials separating or scalping machine particularly adaptable to separation of oversize particles from mine-run ore and to separation of oversize materials from overburden. In construction, unit is a set

For more facts circle 893 on Reader Service Card p 222

of transverse bars of manganese steel, or other wear-resisting alloy steel, each having an elliptical cross section with major axes of adjacent bars displaced by 90 deg. When rotating in union, the predetermined space between bars remains constant. In operation, fine material passes through spaces between bars; large particles travel along feeder to be discharged over end of last bar. —Universal Engineering Corp

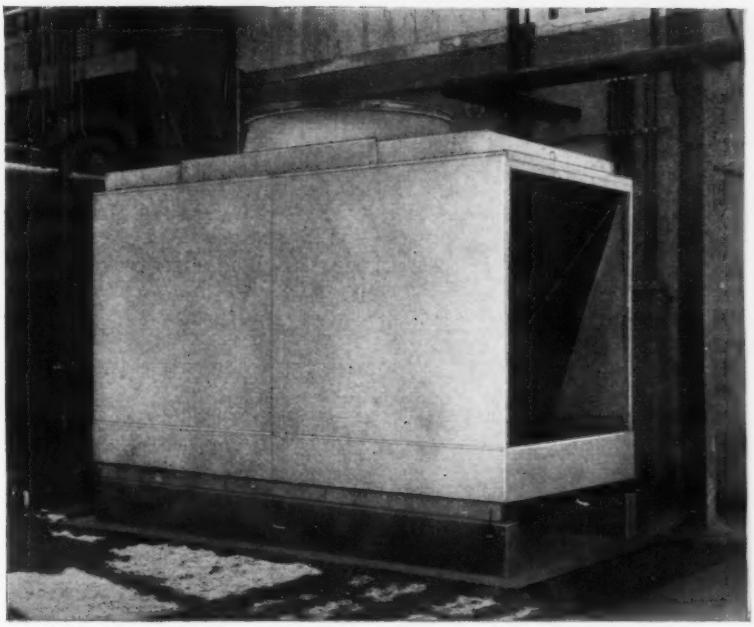
226 **Frozen carloads** of coal are easily dumped after thawing by light oil- or gas-fired unit. Perforated roll units are placed in two rows under cars and a row along each side to quickly thaw loads for dumping. Operating costs are reported as low as 4 cents per ton of coal dumped. — The North American Manufacturing Co

227 **Double-swivel** mounted Airslide fluidizing conveyor feeds an unlimited number of locations within its scope of movement, can be maneuvered by one man from one discharge point to another. Unit handles dry pulverized, crushed and granular material pneumatically in bulk.—Fuller Company

228 **Automatic** car dumper sampling system takes sample from below top layer, thus offers coal consumer a better cross-sectional sample automatically as load is dumped. Unit is mounted on rotating table of car dumper and takes its sample as car is rotated into dump cycle. As dumper is reversed, righting the car, the sample taken falls by gravity into a collecting hopper which automatically discharges collected sample into a chute and conveyor system.—The Fairfield Engineering Company

229 **Three-stage design** of conveyor's belt cover gives it gripping power to handle all types of packages from cans to rough cloth bags on inclines up to 45 deg. Criss-crossing ribs form small, open-center diamonds on surface of belt. Ribs are constructed with a "step-down" design: as each step in the ribs wears down, a new rib is presented for use. This design also makes top and second ribs more stable because of their broader supporting bases.—Goodyear Tire & Rubber Company

(*Continued on page* 270)



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MARLEY'S PACKAGED DOUBLE-FLOW AQUATOWER* can quickly turn waste into *profit* if there's a place in your plant where water is being used at the rate of 200-400 gpm—for process cooling, for air conditioning, for refrigeration, for humidification, or other plant services.

The "P.A.Q." is low in intial cost, and soon pays for itself many times over by saving more than 95% of the water now wasted. It is designed to go on the job quicker, stay on the job longer, and turn in a better performance than any other packaged product. Installation couldn't be more economical, for the Packaged Double-Flow Aquatower is shipped assembled (simply hoist it . . . pipe it . . . wire it . . . and it's in service!). Piping is simple and economical, for the tower's compact design and low-silhouette permit location near the equipment to be cooled.

The Packaged Double-Flow Aquatower is just a part of the complete Marley line of packaged and custom-designed towers that are saving millions of down-the-drain dollars for industry. For information on Marley towers, contact your Marley Sales Engineer in 56 cities, or write today.

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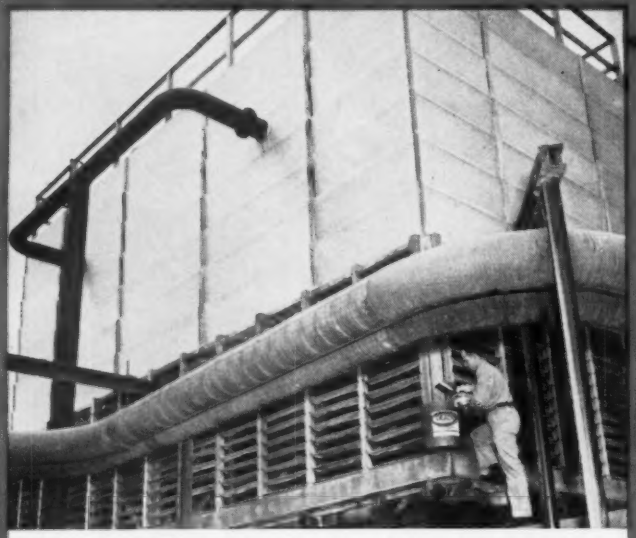
Mallinckrodt Chemical Works selects DEADY CHEMICAL COMPANY on the basis of quality of products and service



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MATERIALS HANDLING, STORAGE

230 **One solution** to problem of material carryover on conveyor-belt systems is unit type brush made up of several heavy-duty helical brushes set in strips. Rotary setup gives effective sweeping action; interrupted face allows individual strip brushes to flex and clean themselves. In one application, brushing unit is driven by belts from the header roll. A counterweight regulated by dampening spring maintains brush contact with belt, compensates for wear.—Osborn Manufacturing Co

231 **New settling tank** is designed to give uniform influent distribution across tank, steady flow throughout entire tank length, even effluent discharge from tank's surface. Unit combines a rapidly sloping bottom with multiple effluent weirs for efficient solids removal and lowered construction costs. Sludge collector provides positive removal of (1) scum from surface of liquid (2) sludge from tank bottom.—Link Belt Co

232 **Mixer-disperser** combines mixing advantages of diamond-shaped agitator, rotating on its angular axis, with mulling, shearing and impinging action of revolving disperser head. Turning at 3600 rpm, disperser head forces material into mulling zone, out towards sides of rotating change can, where it is again swept into agitator blade and mixing-dispersing cycle is repeated.—Troy Engine & Machine Company

233 **Packaged belt conveyor** comes in 12-ft sections with head and tail assemblies, supporting "A" frames and intermediate sections of bent-plate decking. Conveyor is made in 18-, 20-, 24-, 30- and 36-in. belt widths, with drives ranging to 50 hp. The 12-ft sections offer flexibility in lengthening, shortening, altering the conveyor. — Stephens - Adamson Manufacturing Company

234 **Plastic cover** for small-diameter fixed-roof tanks is installed in sections through roof manhole, floats on top of liquid to cut down evaporation, breathing, filling losses. Cover assembly is made of rigid polyisocyanate foam having low density and high load-carrying capacity. Cellular structure makes foam more buoyant. It can withstand –94 to 300 F.—Hammond Iron Works

For more facts circle 895 on Reader Service Card p 222

Begins on page 268

235 **Tank protection** is offered by special alkaline-alloy metal bar, 4-in. long, that is suspended from wire attached to storage-tank cap. By neutralizing catalysts and corrosive acids, unit eliminates varnish and sludge in heating oils, reduces corrosion of industrial fuel-storage tanks. Cap, wire and bar come packaged and are available for indoor, outdoor or underground tanks.—Johns Mfg Co

FREE BULLETINS on MATERIALS HANDLING, STORAGE: To get your copies circle key numbers on convenient Reader Service Card provided on page 222

629 **Car dumper,** rotary type for handling hopper and gondola cars, is described in 16-p bulletin 957. Heyl & Patterson, Inc

630 **Overhead** and in-floor conveyors are topics of illustrated 8-p bulletin. Conveyor Systems, Inc

631 **Pneumatic conveyor** systems for bulk materials are listed in 4-p bulletin P58G. National Conveyors Company

632 **Airstream conveyors** are subject of 32-p bulletin 530. Contains technical data, system diagrams. Dracco Corporation

633 **Pneumatic transmission** line is described in 4-p spec sheet G91-9. Bailey Meter Company

634 **Magnetic equipment** is subject of 48-p booklet. Includes data on automation units, vibratory equipment, separators. Eriez Manufacturing Company

635 **Vibratory** bulk materials-handling equipment including vibrators, packers and jolters are detailed in 60-p catalog 5712. Gives full specs. Syntron Company

636 **Loading assemblies,** bulk plant loading and unloading equipment are detailed in 24-p bulletin F-32. Includes engineering data on spring-balanced and counterbalanced assemblies, component parts, tank car loading gear. Jordan Corporation

637 **Heavy-duty feeders** are discussed in 20-p bulletin CC2-57. Features data on elliptical bar feeders and manganese feeders. Universal Engineering Corporation

638 **Ceramic magnet** pulleys for tramp-iron separation in belt-conveyor systems are discussed in 4-p bulletin 1021. Stearns Magnetic Products

639 **Vertical transportation** equipment, from Autotronic elevators to escalators, is described in 32-p catalog. Otis Elevator Company

(Continued on page 272)

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1. DRIED FILM THICKNESS
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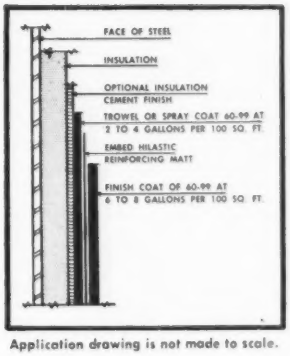
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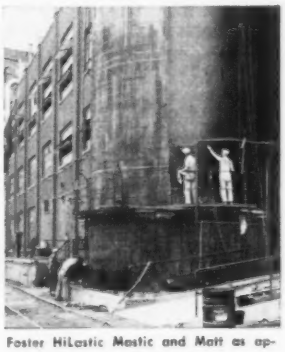
EMBED HILASTIC REINFORCING MATT
FINISH COAT OF 60-99 AT 6 TO 8 GALLONS PER 100 SQ. FT.

Application drawing is not made to scale.

HERE'S HOW

HERE'S RESULT



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For more facts circle 896 on Reader Service Card p 222

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MATERIALS HANDLING, STORAGE

Begins on page 268

640 **Bucket elevators** are described in 36-p bulletin. Includes selection data, specs. Chain Belt Company

641 **Electric hoists** are covered in 8-p bulletin DH-133D. Units of 500- to 4000-lb capacity are described and illustrated. American Chain & Cable Company, Inc

642 **Overhead** traveling cranes, double- and single-girder types in top-running and underhung designs, are detailed in 10-p bulletin 900. Robbins & Myers, Inc

643 **Idlers** with low maintenance requirements are covered in 8-p bulletin 925. Includes data, drawings on all types of conveyor-belt units. Jeffrey Manufacturing Co

644 **Ball-bearing trolleys** are listed in 20-p booklet 2636. Units come in two series for 3-, 4-, 6-in. I-beam tracks. Link-Belt Company

645 **Wire rope** use and care is given in 36-p handbook. Includes selection data, methods of socketing, splicing and installing. Wire Rope Corporation of America

646 **Delivery system** for bulk gases is subject of 16-p bulletin ADC663A. Includes related info on control equipment, distribution pipelines. Air Reduction Company, Inc

647 **Sling chains** are described in 28-p bulletin DH-105. American Chain & Cable Company, Inc

648 **Bin-level indicators,** aerators are detailed in 20-p catalog. Gives complete specs, schematics. The Bin-Dictator Company

649 **Storage tanks** are described in 36-p catalog 58G. Covers all types of storage systems, gives detailed plate-fabrication information. Hammond Iron Works

650 **Floating-roof tanks,** double-deck pontoon and pan types, are treated in 4-p bulletin 158. Includes diagrams. Nooter Corp

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YOU get the highest possible accuracy of reading on low temperature, low boiling point liquids with the patented Jerguson Non-Frosting Gage in the New Large Chamber model . . . because it insures less turbulence at the meniscus, and clear vision at the vision slot.

This new Jerguson model has 6 times larger area at the meniscus than the standard gage, so that there is a marked reduction in turbulence with light gaseous fluids that tend to boil or surge. Moreover, the problem of frosting encountered with these liquids has been eliminated by a patented frost preventing unit extending from the gage glass. This special transparent unit projects beyond the cover bolts and prevents frost from building up over the vision slot.

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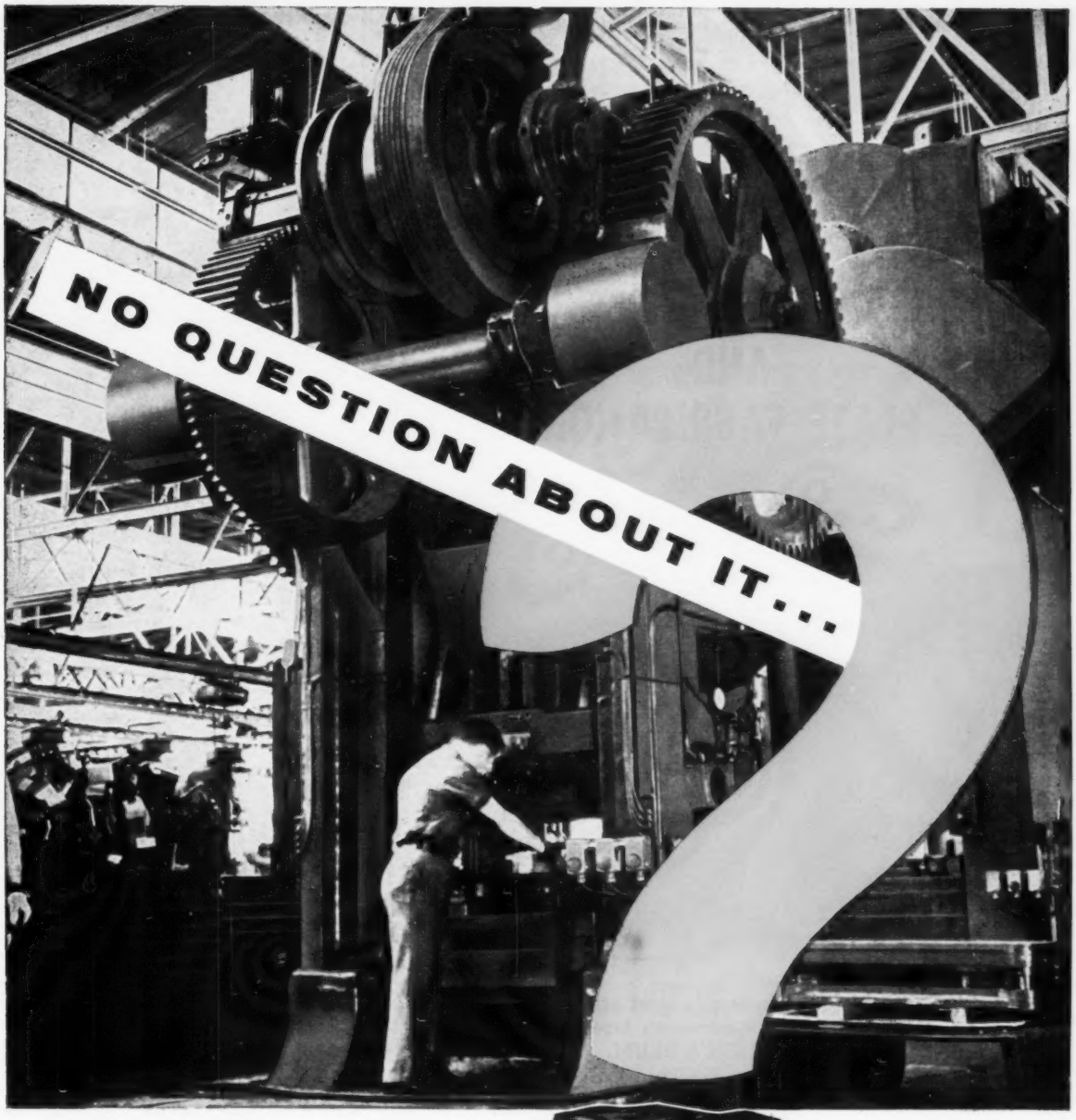

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LUBRICATION

As you read through the items listed below, take note of the number of terms which were little known some years back: *radiation-resistant, multipurpose lube, fire-resistant fluid, extreme-pressure lube, molybdenum disulfide lube.* They indicate but a few of the changes that are taking place in lubrication; help explain why there is a growing need for lubrication engineers throughout industry. Much of the research now under way by lubricant suppliers is aimed toward developing even better products to cope with higher temperatures, higher speeds, higher bearing loads . . . while keeping the number of lubes in your plant to a minimum.

Managing Editor

NEW LUBRICATION EQUIPMENT and PRODUCTS: To get complete information, circle key numbers on Reader Service Card provided on page 222

236 **Centralized lube system** is for use on machinery with numerous bearings, limited installation space. Low-pressure positive-displacement system lubricates industrial vehicles, machinery such as production, high-precision, "bottleneck" and "24-hr" machines. Miniature meter valve, slightly larger than lube fitting, services each bearing individually.—Stewart-Warner Corp

237 **H-p hydraulic handgun** is designed for plug-valve lubrication.

For more facts circle 900 on Reader Service Card p 222

TWO KEELER DK PACKAGE STEAM GENERATORS provide

STEAM *for* HEAT, HOT WATER and AIR CONDITIONING

THE DALLAS MEMORIAL AUDITORIUM

— Architect-Engineer —
George L. Dahl Architects & Engineers
Dallas, Texas

— General Contractor —
R. P. Farnsworth & Co., Inc.
New Orleans, La.

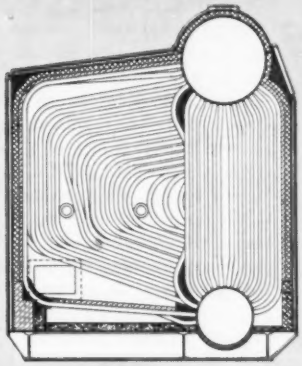
— Heating, Plumbing, Air Conditioning —
C. Wallace Plumbing Co., Inc.
Dallas, Texas

After well over a year of service in this fabulous community center, the two 15,000-lb. capacity gas-fired Keeler D K Package Steam Generators are still winning highest commendation. *"Performance 100% perfect . . . very economical and up to date . . . operating without trouble"*—are just a few of the comments!

The Dallas Memorial Auditorium is typically Texas-big . . . 1,773 seats in its theatre, 10,439 seats in its arena, over 110,000 square feet of exhibit space, a spacious lobby—422,710 square feet of total area! It's heated and air conditioned throughout with low cost, low maintenance steam from two 250 psi design pressure Keeler D K Package Steam Generators.

The heat and hot water requirements of the auditorium are met with time-proven Keeler dependability . . . and steam from the same units drive the turbines for the air conditioning system's two 775-ton centrifugal refrigeration compressors—with capacity to spare!

Multi-purpose Keeler D K's offer the popular D-type tube arrangement in a completely steel encased package, with water cooled and insulated furnace sides, roof and floor as well as front and rear walls. Write or phone for full specifications . . . *Keeler versatility is at your service!*



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- Oil or gas fired.
- Steam capacities up to 60,000-lbs. per hour.
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For more facts circle 901 on Reader Service Card p 222

ACE Plastic Pipe

85 to 100% of your corrosion-resistant piping needs now available from 1 source

- CHOICE OF 9 DIFFERENT TYPES
- THE NEWEST OF MATERIALS
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HOW TO SELECT THE RIGHT PIPE

	TYPE	SIZES	PROPERTIES	VALVES	ASK FOR BULLETIN
1	ACE-ITE	Threaded Pipe ½ to 6″	General purpose rubber-plastic blend. Tough, impact resistant, economical. Handles most common chemicals to 170°F.	Diaphragm valves with Ace-Ite body, ½ to 2″	80-A
2	RUBBER-LINED STEEL	Flanged Pipe 1½ to 24″ and up	Strength of steel, resistance of hard rubber. Soft-rubber inter-layer aids shock-resistance. Finest for alkalis, most inorganic acids, many organic acids, all salts.	Rubber-lined C.I. Gate, Darling Gate & Check Valves to 24″. Diaphragm Valves to 6″	CE-52
3	ACE TEMPRON	Threaded Pipe 1 to 8″	Best anywhere for hot inorganic chemicals, acids, etc. to 260-275°F. Also wide variety of organics. Excellent rigidity.	— —	96-A
4	ACE RIVICLOR	Threaded Pipe ½ to 4″	Rigid PVC. Excellent aging. Good cold impact strength. Not affected by most inorganic acids and alkalis. Also good for many organics.	Diaphragm valves with Riviclor body ½ to 2″	CE-56
5	ACE PARIAN	Threaded Pipe ½ to 2″	Odorless, tasteless, rigid polyethylene, best for sub-zero uses. Best resistance of any plastic at room temp. except to acetic acid.	Diaphragm valves with Parian body, ½ to 2″	351
6	ACE HARD RUBBER	Threaded ½ to 4″ Flanged 1½ to 8″	The oldest, still tops. Extreme resistance to alkalis, inorganic acids, many organics, all salts. Ideal for chlorine, fluorine. Widest range of fittings.	Rubber-lined or plastic valves above. Also many plug valves, bibb cocks, etc.	CE-51
7	ACE SARAN	Threaded Pipe ½ to 4″ Tubing ⅛ to 1¼″	Odorless, tasteless, general-purpose. Strong, takes high pressures. Not affected by most inorganic acids and alkalis; resistant to most organics.	Diaphragm Valve with Saran body ½ to 2″. Also Saran-lined diaphragm valves to 6″ and up	CE-58
8	ACE-FLEX	Flexible Tubing ⅛ to 1¼″	General-purpose transparent flexible tubing. Non-toxic, odorless, tasteless. Can steam sterilize. Excellent for chemicals.	Ace hard rubber plug valves, bibb cocks, etc.	66
9	SUPPLEX	Flexible Pipe ½ to 2″	Non-toxic flexible polyethylene pipe. Ideal for water distribution lines, drain lines, jet wells, etc. Resistance similar to Parian. Uses insert type fittings.	Diaphragm valves with Parian body, ½ to 2″	CE-57

ACE Saran, Supplex, Ace-Ite and Riviclor are approved by The National Sanitation Foundation for drinking water.

RUBBER AND PLASTIC LINED TANKS, PUMPS, MOLDED PARTS, ETC., FOR ANY NEED

AMERICAN HARD RUBBER COMPANY

Division of Amerace Corporation

ACE ROAD • BUTLER, NEW JERSEY

SEE ACE EQUIPMENT IN CHEMICAL ENGINEERING CATALOG

Begins on page 274

Light, rugged unit, designated Model 400-C, is self-priming, can be used in any position.—Rockwell Manufacturing Company

238 **Automatic conveyor oiler** applies an even film of oil to chain links and pins by direct contact of oil-carrying felt rollers. There is no mist, spray or drip. Independent hinging maintains roll pressure despite conveyor-chain sway.—Olsen Manufacturing Company

239 **Constant-level oiler** covers capacity range of 2 oz to 1 gal. Advantages reported are: (1) large internal passages for use of heavier oil (2) top filler cap (3) remote mounting.—Oil-Rite Corporation

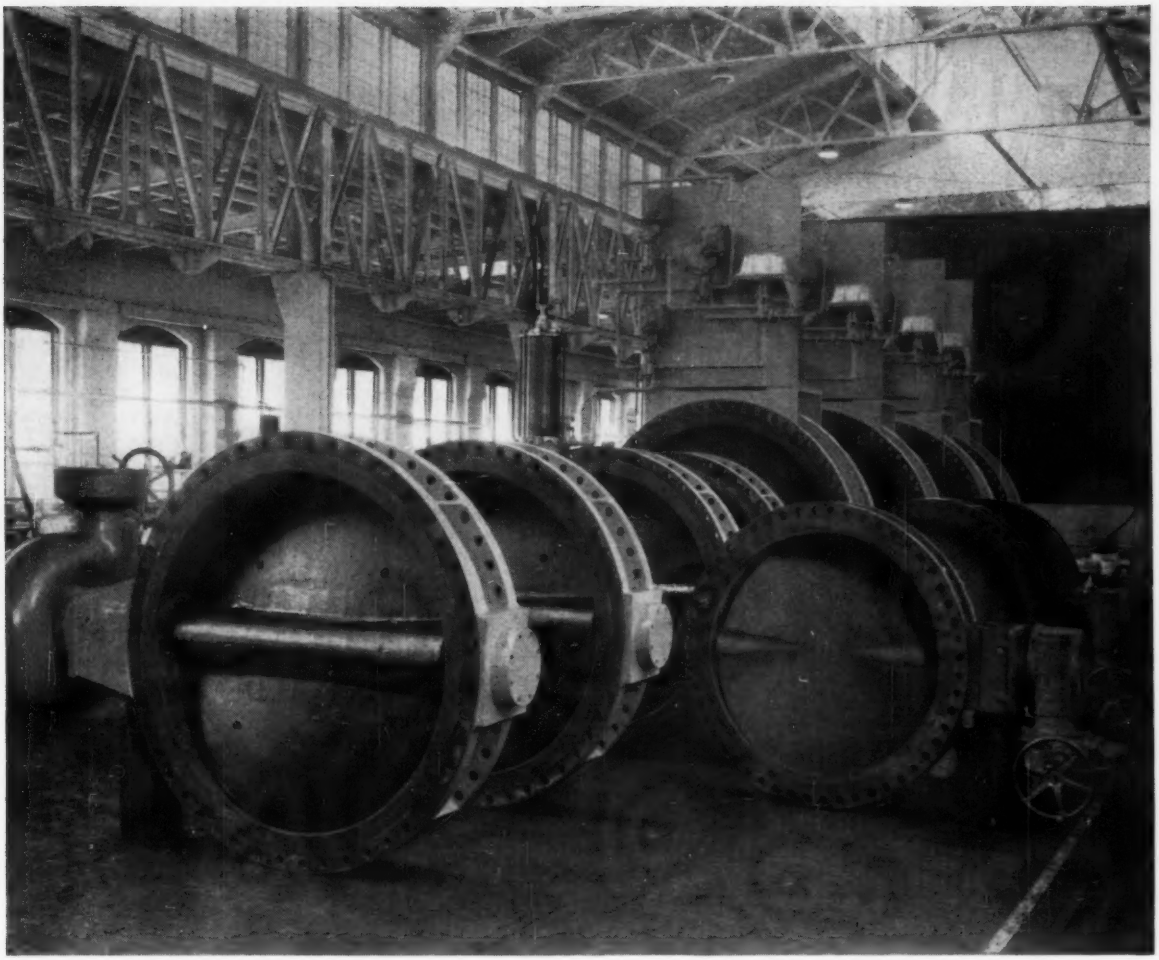
240 **Hydraulic lubricator** is for use where lube discharge per machine cycle is relatively small. Unit operates on any pressure line from 500 to 3000 psi, delivers 2 cc of oil per lubricating cycle.—Bijur Lubricating Corporation

241 **Production sprayer** is designed for applying molybdenum disulfide lubricant. Lube comes packaged in self-pressurized 5-gal container with spray gun and 9-ft hose. Gun has long nozzle, pistol-grip handle.—Tower Oil Co

242 **Spray lubricator** continuously, automatically coats chains that are moving rapidly or are close coupled. In operation, air passes through solenoid valve into lubricator's reservoir; lube is conducted from reservoir through tubing to spray outlet nozzles.—J N Fauver Company, Inc

243 **Alarm system** for force-feed lubricators shuts down compressor if lubricator stops rotating and/or oil level drops in reservoir. Unit consists of small pump, bleed down chamber and pressure switch that is actuated by pressure in bleed down chamber. As long as pressure is maintained, an uninterrupted signal is furnished by pressure switch. If pump should not receive oil, or cam shaft should stop rotating, signal is interrupted. Manzel Div of Houdaille Industries, Inc

244 **Lubrication fittings** do away with conventional relief plugs, speed and simplify lubrication of rolling-contact bearings in motors, pillow blocks or any ball or



Three recent orders—60-inch, 72-inch and 90-inch SMS rubber-seated butterfly valves—are shown prior to shipment from SMS Plant 1 in York. Note how the through-type rubber body liner completely covers and protects the bore of the valve.

Only SMS Rubber-Seated Butterfly Valves give you **COMPLETE BODY PROTECTION**

When used on condenser and circulating water service, SMS rubber-seated butterfly valves will give you dependable operation and few maintenance problems. The through-type of rubber seat—exclusive in SMS valves—covers the entire inner body to assure complete internal protection, eliminate tuberculation and oxidation. You get a smoother flow pattern, with no inner mechanical retaining plates to corrode or dislodge.

SMS rubber-seated butterfly valves are easy to operate, will provide 100% effective shutoff with a 125-pound pressure drop. Wedging action of the vane against the tough flexible rubber seat assures positive closure, even around the shaft bosses. By resetting the stops in the operator these angle-seated vanes can be adjusted to give tight shutoff throughout the life of the valve.

To obtain complete information on power plant applications for the full SMS line—Butterfly Valves, Rotovalves and Ball Valves—see our local representative, or write S. Morgan Smith Co., York, Penna.

S. MORGAN SMITH SMS HYDRODYNAMICS

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

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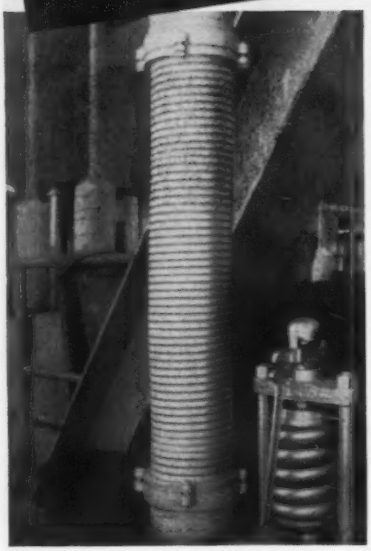
For more facts circle 903 on Reader Service Card p 222

PENFLEX

• CUSHIONS SHOCK
• PREVENTS BREAKS



PENFLEX TUBING ABSORBS THERMAL EXPANSION SHOCKS

Thermal expansion 900°F . . . pressures up to 850 psi. . . . impact and pipe movement under terrific strain, but Penflex safely handles them all. That's the story of Penflex 8" I.D. galvanized steel interlocked tubing welded into the pipeline, eliminating the cost of flanging the joint as well as the pipe. This was installed as an expansion joint on safety blow-off valves.

Wherever thermal expansion, pressures and shock are factors in keeping steam, air, water or chemical lines from breaking you can rely on Penflex Interlocked Tubing and Penflexweld High Pressure Tubing. Available in steel, bronze and stainless steel from ⅛" I.D. to 24" I.D. Write for complete details to Pennsylvania Flexible Metallic Tubing Company, Inc., 7237 Powers Lane, Philadelphia 42, Pa.

GET NEW DATA BOOK AND CATALOG

PENFLEX

TIGHT AS A PIPE BUT...
FLEXIBLE

roller bearing housing equipped with relief plugs. Tests are reported to show that RT fittings can cut lube time 80% and more. —Keystone Lubricating Company

245 **Radiation-resistant** grease is for use in nuclear power plants where it is subjected to atomic radiation. Known as Shell APL, it fared well during company-conducted static radiation tests and AEC mechanical stability tests.—Shell Oil Company

246 **Industrial grease** copes with bearing applications where high pressures and shock loads exist, or where there is a tendency for fretting corrosion to occur. Identified as Gulfcrown Grease EP, it meets severe conditions of steel mill rolls, oscillating shafts, crushers, gears, cams, rotary kiln bearings, etc. Satisfactory performance is obtained at 250 F.—Gulf Oil Corporation

247 **Multipurpose lubricant** is applicable to plumbing and heating needs as well as conventional grease-lubricated gearings and other machine elements. Retains normal texture, structure, consistency at extremes of heat and cold.—J A Sexauer Mfg Company

248 **One grade of grease** for many applications replaces variety of special-purpose greases. Calcium-EP-complex lube withstand extreme pressures and has long service life. It is water-resistant and maintains chemical stability in temperatures from −15 to 300 F.—Socony Mobil Oil Co, Inc

249 **High load-carrying lube** is designed expressly for trouble-free cylinder lubrication of free-piston gas generators. Oil minimizes ring and cylinder liner scuffing and scoring, ring wear, deposit formation in engine case and on compressor delivery valves.—Shell Oil Company

250 **Fire-resistant qualities** of "snuffer" type hydraulic fluid prevent it from burning on contact with flames, heated metal surfaces or molten metal. A special formulation of water, petroleum hydraulic oil and emulsifying agents, the fluid is particularly suitable for use in industries where hydraulic leaks or line ruptures would be immediate fire or explosion haz-

LARSON-LANE STEAM AND CONDENSATE ANALYZERS

FOR ACCURATE MEASUREMENT OF STEAM CONDUCTIVITY

MOST modern and efficient system of removing volatile amines, ammonia and carbon dioxide prior to recording steam conductivity. This thoroughly effective steam degasser uses a cation exchange resin for the removal of ammonia, morpholine, cyclohexylamine, and reboiling for the removal of CO_2. Constant sample temperature is maintained. Taps provided for drawing sample for other analyses.

Larson-Lane Steam and Condensate Analyzers make possible rapid and accurate measurement of steam purity, completely essential for efficient boiler operation.

A smaller, less expensive unit, the CH-16 provides for removal of ammonia and amines from steam condensate without the necessity of reheating. Condenser leakage is readily detected with this model in the presence of volatile amines or ammonia.

Write today for complete technical details.

Industrial Instruments Inc.
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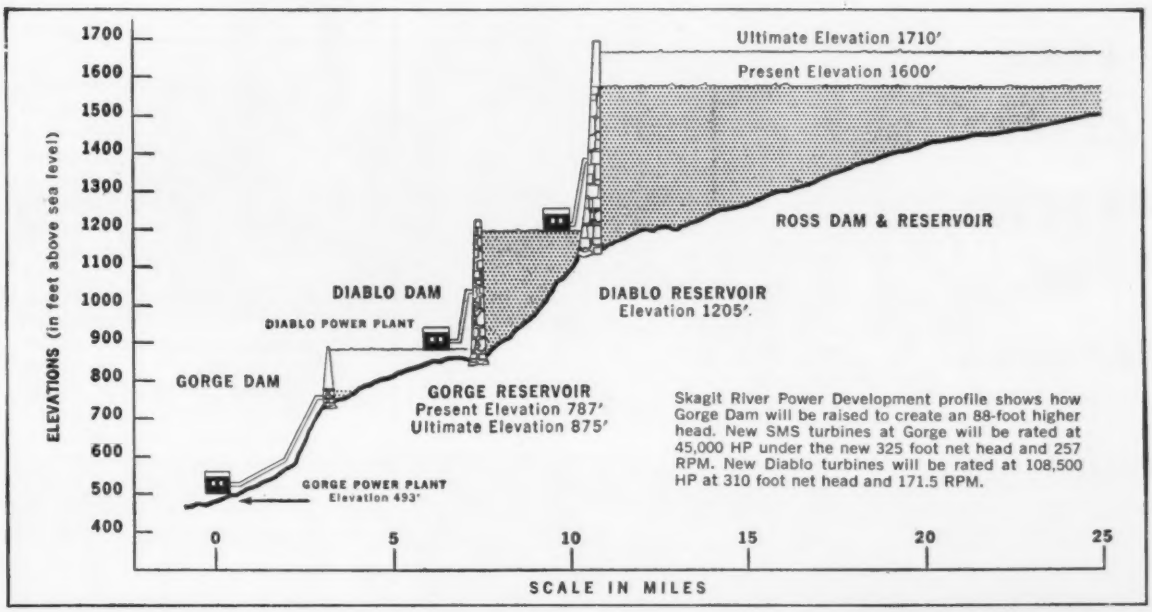
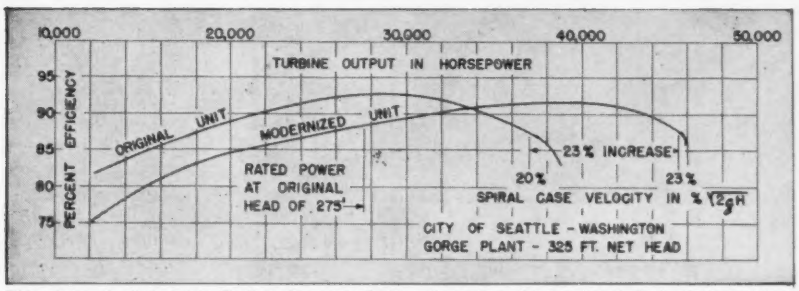
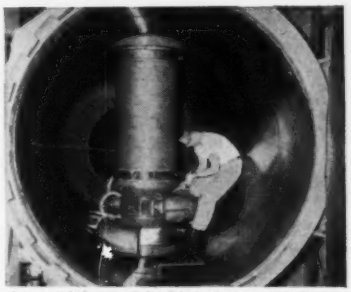
circle 905 on Reader Service Card p 222



Skagit River Power Development profile shows how Gorge Dam will be raised to create an 88-foot higher head. New SMS turbines at Gorge will be rated at 45,000 HP under the new 325 foot net head and 257 RPM. New Diablo turbines will be rated at 108,500 HP at 310 foot net head and 171.5 RPM.



This shows the Laboratory Test performance (power stepped up for head and size), of the existing Gorge runners under the higher head and the new runner and gate design for the same conditions.



A complete model of the Gorge wheel case assembly, built to extreme accuracy, is shown being mounted in the test chamber of the SMS high-head test stand.

CITY OF SEATTLE TO GET MORE POWER

New SMS Turbines In Modernization of Gorge, Diablo Facilities Will Help Increase Capacity 23%

As part of its program to get more power, Seattle, Washington's Skagit River development includes replacement of 35- and 22-year-old turbine runners at the Gorge and Diablo plants, and increasing the height of the Gorge Dam. Rebuilt vertical SMS-Francis runners and new wheel case accessories will give each unit 23% more capacity in the existing wheel cases.

Extensive model tests were conducted for these turbines in the SMS Laboratory's high-head test stand. They proved that the proposed new runner and modified gate designs would not only provide the increased power with very little loss in efficiency, but would have improved cavitation characteristics which permit maintaining the original setting above tailwater elevation.

Research results such as these indicate SMS can provide substantial economies in both new and existing installations with higher turbine speeds and settings as well as smaller spiral cases and inlet valves. A general discussion of turbine rehabilitation, as given at a recent technical presentation, is available without cost. Write on company letterhead to S. Morgan Smith Company, York, Pennsylvania.

In-Service date of first Diablo Unit: August 1, 1958. City of Seattle advises that, prior to testing, performance to date indicates that anticipated increase has been substantially met.

More Power To . . .

LIVE BETTER ELECTRICALLY

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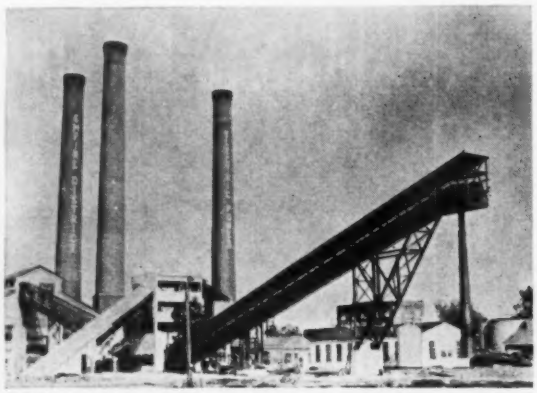
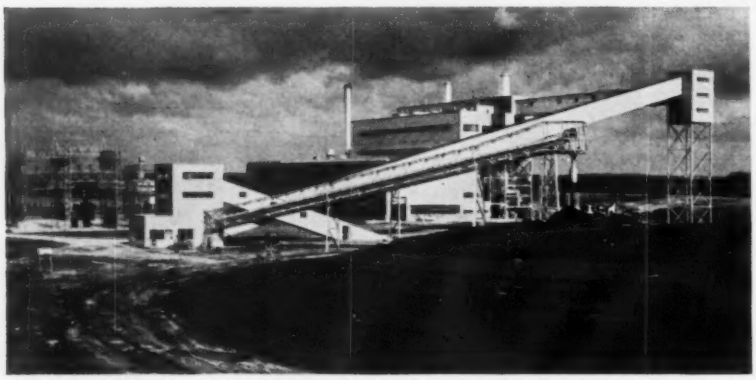
EARN EXTRA PROFITS IN SAVINGS



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.



McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

—With Cost-Cutting

COAL-HANDLING SYSTEMS

Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

McNALLY PITTSBURG
"The Men Who Know Coal From The Ground-Up"

McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ Title_____

Company_____

City and State_____

Begins on page 274

ards. Irus Fluid 902 eliminates possibility of combustion by releasing its water content as a protective steam blanket to quench fire. "Snuffer" action reduces local temperatures, displaces oxygen from the immediate area.—Shell Oil Company

251 **Extreme-pressure lube,** designated Molylube 110-L, comes packaged in self-contained polyethylene oilcan that is shatterproof and reusable. The solvent-refined petroleum oil contains a stable dispersion of molybdenum disulfide, imparts a tough film capable of withstanding shock loads and wiping action. High-viscosity index makes it good for h-t use.—Bel-Ray Company, Inc

252 **New grease,** developed to meet today's high-speed high-temperature lubrication requirements, has operating range of –45 to 600 F at speeds to 30,000 rpm. Designated grades ETR Grease B and ETR Grease D, it meets most needs for extreme-temperature lubrication of rolling contact bearings. In a test rig operating at 10,000 rpm, the grease is reported to have performed satisfactorily for 1181 hr at 450 F, 162 hr at 600 F.—Shell Oil Company

LUBRICATION BULLETINS: To get your free copies, circle key numbers on Reader Service Card. See page 222

651 **Circulating oil system** with automatic alarm, variable delivery pump is described in bulletin 70. The Farval Corporation

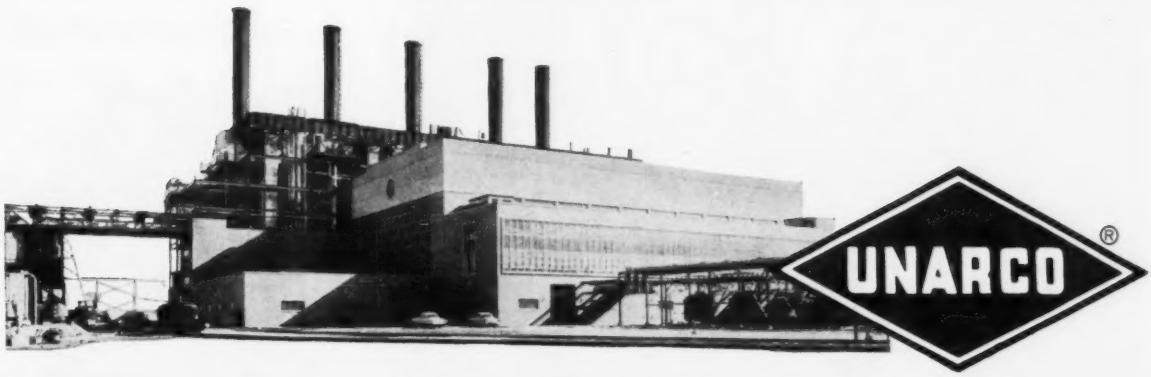
652 **Lubrication systems** for small machines are detailed in 24-p bulletin 4C. Features cyclic and "one-shot" lubricators. Bijur Lubrication Corporation

653 **"Planned lubrication"** is title of 20-p bulletin BK-19-a. Aids in lube selection, shows how most plant needs can be met with minimum of lube types, densities. Keystone Lubricating Corp

654 **Molybdenum disulfide** lubes are topic of 16-p bulletin 110. Technical aspects of extreme-pressure lubes are discussed. Alpha Molykote Corporation

655 **Valve lubricants** are covered in 12-p bulletin containing selection charts, servicing info. Rockwell Manufacturing Company

656 **Silicone lubricants** are discussed, illustrated in 8-p bulletin 6-101. Dow Corning Corporation

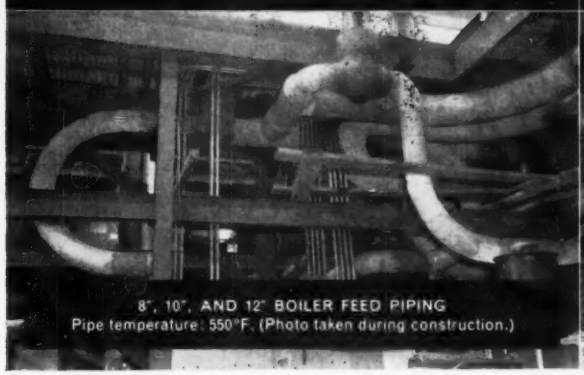


at the new Linden Generating Station, too!

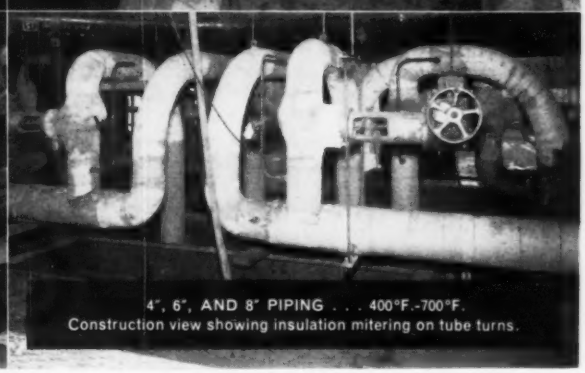
UNIBESTOS

...WORLD'S FINEST PIPE INSULATION

30" AND 16" PROCESS STEAM LINES
Pipe temperature: 750°F. (Photo taken during construction.)



8", 10", AND 12" BOILER FEED PIPING
Pipe temperature: 550°F. (Photo taken during construction.)



4", 6", AND 8" PIPING . . . 400°F.-700°F.
Construction view showing insulation mitering on tube turns.

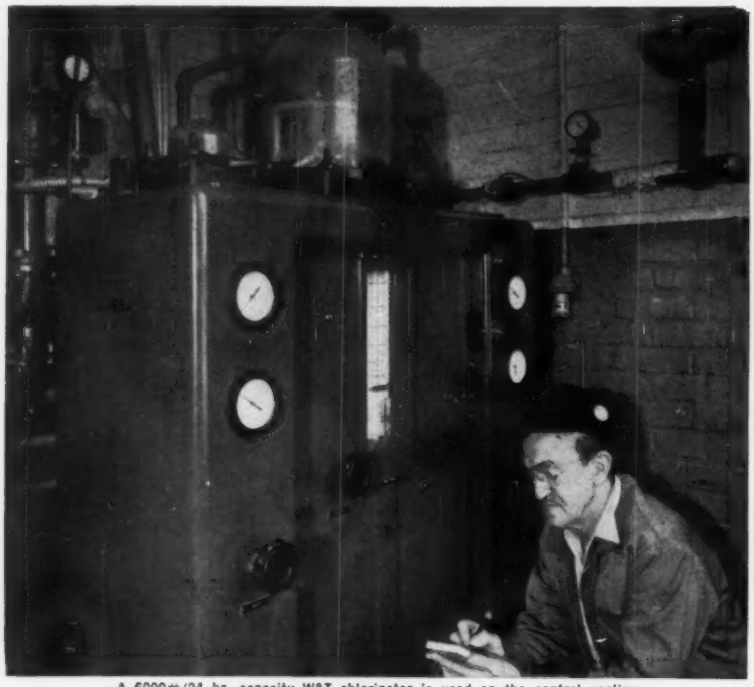
Public Service Electric and Gas Company is meeting the increasing needs of over one and one-third million customers in 223 New Jersey communities with the output of the new Linden Generating Station and that of their five other generating facilities.

Here, as elsewhere, today's high fuel and operating costs give added importance to the engineer's search for maximum financial and thermal economy . . . a problem UNARCO has helped power plants solve—coast-to-coast, border-to-gulf—with efficient UNIBESTOS® pipe insulation. UNIBESTOS is used at Linden on the major portion of piping.

UNIBESTOS is easy to install, cuts clean when mitering . . . withstands impact, vibration, moisture, fumes . . . seals at joints *without* calking . . . can be removed and re-used repeatedly without damage or loss of efficiency. It's the *only* pipe insulation made almost entirely of tough Amosite asbestos. *Union Asbestos & Rubber Co., 1111 W. Perry St., Bloomington, Ill.*

look to UNARCO . . . for insulations, turbine blankets, insulating cements, asbestos textiles, protective coatings, packing, and gasketing. Distributors coast to coast.

For more facts circle 908 on Reader Service Card p 222



A 6000#/24 hr. capacity W&T chlorinator is used on the central cooling water system at Marcus Hook, Penna. refinery of Sinclair Refining Company.

W & T CHLORINATION . . .

the economical way to prevent slime in cooling waters

Water used for cooling operations at the Marcus Hook refinery of Sinclair Refining Company is chlorinated to prevent slimes from fouling plant units and lowering cooling efficiency.

Chlorination of the system is accomplished by one W&T chlorinator operated from a program control panel. The control automatically starts and stops chlorination in accordance with a preselected schedule. Slime growths are eliminated in the cooling units without the need for continuous treatment.

For information about W&T chlorination for slime elimination write for Bulletin CD-43.76.

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Accuracy to 1 part in 1,000
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Ranges from absolute zero to 500 psig

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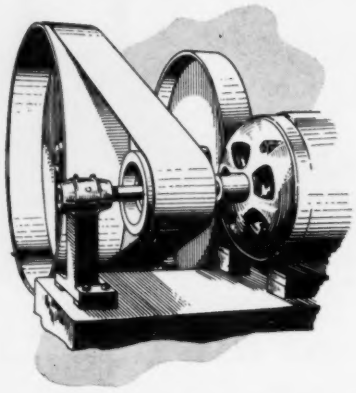
MECHANICAL POWER



MECHANICAL POWER TRANSIMISSION EQUIPMENT: For more details on these recent developments, circle key numbers on Reader Service Card, p 222

253 **Dry fluid drives** and couplings (Flexidyne), made in a wide size range, cope with difficult drive problems, especially those involving high inertia starts and damage due to overload. Starting torque can be tailored to driven-load requirements by varying flow charge, which consists of heat-treated steel shot contained in the housing. When motor or engine is started, centrifugal force throws flow charge to perimeter of housing, packing it between housing and rotor, which transmits power to driven load. After initial period of slippage, housing and rotor become locked together and achieve full load speed, operating without slip and with 100% efficiency.—Dodge Manufacturing Corporation

254 **Speed reducers** adapt to any mounting position, provide output speeds of 10 to 431 rpm, capacities of 1/6 to 15 hp. Units are available in three types: V-belt, sprocket or gear drive to input shaft; direct motor drive to shaft; motorless to attach to customer's motor.—Boston Gear Works

255 **Gear reducer** is shaft mounted, eliminates need for motor bases, rails, supports, flexible couplings. Featuring compactness, it makes possible infinite speed ratios through use of variable-speed pulleys or by changing sheaves, sprockets or prime-mover speed. Single-reduction models are 98% efficient, give 4.5:1 speed ratio. Double-reduction types are 96% efficient, give 14.7:1 speed ratio. —Lovejoy Flexible Coupling Co

For more facts circle 909 on Reader Service Card p 222

TRANSMISSION

256 **Reduction gearheads** have been added to motorized variable-speed reducer to provide torque ratings of 20 through 120 in. lb. Combinations give speed ranges from 0-80 to 0-200 rpm. Standard motor is a 48-frame, 115-volt, 60-cycle, single-phase, open drip-proof type.—Revco Inc

257 **Shaft-mounted** all-steel drive is available in single-reduction ratio of 5:1, and in two double-reduction ratios of 144:1 and 25:1. Ratings range from 2 hp at 5 rpm to 50 hp at 359 rpm; maximum torque at low-speed shaft is 31,000 in. lb. Longer center distance between shafts permits larger sheaves on installations where unit is mounted with input shaft toward driven machine or on through-shaft applications.—The Falk Corporation

258 **Screw-conveyor drive** incorporates new design features that simplify maintenance, reduce installation costs. Unit consists of reducer, packing gland and drive shaft, all of which mount as unit on trough end. Heat-treated helical steel gears and pinions give 97% efficiency to the unit.—Dodge Manufacturing Corp

259 **Variable-speed drive** uses constant-speed motors, features heat-dissipating design. Built on the eddy-current principle, unit comes in four dripproof models in six sizes. Models include a separate controlled-slip coupling, various combinations to serve as variable-speed gearmotor, variable-speed motor or special unit for integral mounting of speed reducers. Dc power supplies are not needed. Drive is reported to operate stalled at full torque without overheating when driven by 100-hp 1750-rpm motor.—Cone-Drive Gears, Div of Michigan Tool Company

260 **Helical gear drives** boast ratios to 2217:1, capacities to 200 hp. Gear setup consists of helical gear trains operating in high-capacity ball and roller bearings mounted in a cast-iron housing. Input and output shafts are in same horizontal and vertical planes.—Link Belt Company

261 **Shaft-mounted gearmotor** provides remote electrical control with indication of position, speed,

4-pass design:

High fuel-to-steam efficiency for greater fuel economy

EVERY CLEAVER-BROOKS boiler has 4-pass fire tube construction — to scrub more heat from the flame. Maintains high flue-gas velocity . . . to provide right conditions for optimum heat transfer. This is just one of the Four Design Standards that make pre-engineered Cleaver-Brooks boilers your best packaged-boiler buy.

Other Design Standards

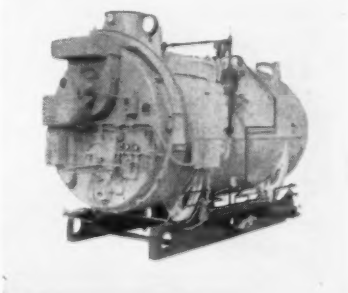
5 SQ. FT. OF HEATING SURFACE per boiler horsepower — prolongs boiler life, assures greater efficiency and lower maintenance.

FORCED DRAFT supplies air for efficient combustion, regardless of draft conditions. Easiest to maintain of all air-control methods.

UPDRAFT CONSTRUCTION — Low furnace keeps hottest combustion gases well below water level for safety's sake.

This exclusive combination of Design Standards is the key to the superiority of Cleaver-Brooks packaged boilers, 15 to 600 hp, 19 sizes, 130 models; steam or hot water; oil, gas or combination oil/gas fired.

For all the facts, call your boiler man from Cleaver-Brooks or write Cleaver-Brooks Company, Dept. L, 301 E. Keefe Ave., Milwaukee 12, Wisconsin.



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ORIGINATOR AND LARGEST PRODUCER OF PACKAGED BOILERS

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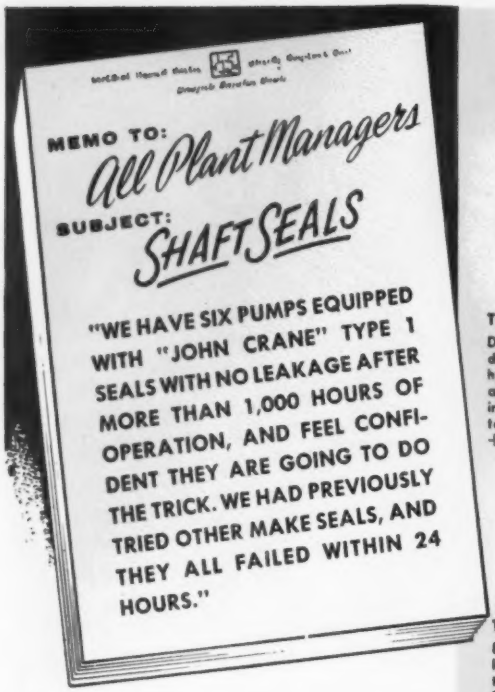
MEMO TO:
All Plant Managers
SUBJECT:
SHAFT SEALS
"WE HAVE SIX PUMPS EQUIPPED WITH "JOHN CRANE" TYPE 1 SEALS WITH NO LEAKAGE AFTER MORE THAN 1,000 HOURS OF OPERATION, AND FEEL CONFIDENT THEY ARE GOING TO DO THE TRICK. WE HAD PREVIOUSLY TRIED OTHER MAKE SEALS, AND THEY ALL FAILED WITHIN 24 HOURS."

This is part of an actual memo sent by one plant manager to others of the same company in different sections of the country—and that company is now exclusively specifying these and other type "John Crane" Shaft Seals for *all* their liquid handling requirements.

You too can save time, trouble and expense by doing likewise.

You'll find a "John Crane" Shaft Seal for every service . . . from hot or cold water to the most destructive acids and corrosives . . . high temperatures, high pressures . . . in types and sizes to meet practically any mechanical or dimensional requirement.

Send us details on your application. We'll recommend the proper shaft seal. Request Bulletin S-204-3 for complete overall information.

Crane Packing Co., 6430 Oakton St., Morton Grove, Illinois, (Chicago Suburb).

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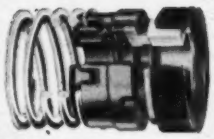
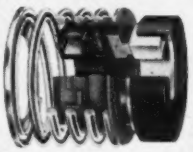


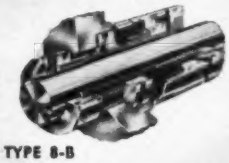
TYPE 1

Designed for limited stuffing box diameter. Handles water, light hydrocarbons, refrigerants, mild acids and other liquids non-injurious to synthetic rubber at temperatures from −40°F. to +212°F., pressures to 200 psi.



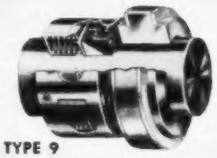
TYPE 2

Designed for limited stuffing box length. Handles same services, temperatures and pressures as Type 1.



TYPE 8-B

Heavy duty, high pressures. Packaged construction for easy installation. Handles pressures to 1200 psi., temperatures from −40°F. to +250°F. Services same as Type 1.



TYPE 9

Famous as a problem solver. Sealing members of chemically inert Du Pont Teflon. Engineered to service conditions to handle practically all destructive acids, corrosives and gases at temperatures from −120°F. to +500°F., pressures to 150 psi. Available in balanced construction for pressures to 750 psi.

valve setting, etc obtained on calibrated meter. Built-in potentiometer gives remote indication and control for valves, variable-speed drives, gates, jacks and variable displacement pumps. — The Jordan Company, Inc

262 **Power-transmission belt** combines polymer and chrome-tanned leather for extra life. Polymer is tensile member, leather is friction surface. Advantages reported are: slip- or stretch-proof operation, speeds to 24,000 fpm, operation at ratios to 20:1; constant speed at low tensions, high tensile strength.—Extremultus, Inc

263 **Double-duty belt** can be turned over after first carrying side is no longer satisfactory. Made of 2- or 3-ply cotton-nylon fabric with a skim coat of rubber between plies, it is reported to be extremely flexible and have high impact resistance for use over smaller pulleys on short center hauls. Envelope ply of double-skimmed open-weave nylon fabric surrounds core and acts as a cushion. —H K Porter Company, Inc

264 **Flexible coupling** is made for shaft diameters to 1⅞ in. It is especially recommended for use as motor coupling, transmitting electric motor power to pumps, generators and speed reducers. Coupling sleeve is one piece, and coupling is enclosed in 2-piece metal cover, sealed to stop loss of lube or entry of contaminants.—Link-Belt Company

265 **Coupling design,** called Paraflex, uses a tire with synthetic tension members bonded together in rubber as its flexing element. Twin flanges mounted on shafts hold tire in place, allowing it to flex under stress. Unit accommodates angular misalignment to 4 deg, parallel misalignment to ⅛ in., and end float to 5/16 in., depending on coupling size and duration of shaft misalignment.—Dodge Manufacturing Corp

266 **Interchangeable bushings,** lube-free operation are features of coupling that handles 1800-in.-lb torque. Stress-relieved injection-molded nylon gears, held in place on steel hubs by spring rings, makes a smooth, resilient contact with steel sleeve. Unit weighs 6½ lb, fits short shaft extensions. —John Waldron Corporation

Begins on page 282

267 **Chain element** of lube-free flexible coupling is made of nylon segments and stainless-steel pins. It can be disassembled or connected at any link without special tools, and fits standard stock steel sprockets. Unit resists corrosion, needs no protective cover. It handles loads from fractional to 40 hp, speeds from 500 to 5000 rpm. —Morse Chain Company

268 **Shaft-mounted** speed-reducer line is designed for many uses. Units are available as single-reduction drives in six sizes, with nominal ratios of 5:1 and capacities up to 50 hp, and double-reduction drives in seven sizes, with ratios of 15:1, capacities to 40 hp. They can be mounted at angular as well as in horizontal positions. Positive lube is assured by live-action oil spray generated automatically through gear rotation. —Link-Belt Company

269 **Positive dry coupling** is made of heat- and oil-resistant neoprene sleeve with axially molded internal teeth. Two metal end-fittings are grooved to match sleeve's teeth. Overall length can be varied by increasing length of sleeve section. Neoprene teeth move easily, positively in end-fitting grooves, eliminating metal-to-metal contact and requiring no lubrication. Two basic hub sizes are offered, with 2-, 4- and 6-ply rubber variations to change torque capacity. Loads to 40 hp at 1750 rpm torque to 1440 in. lb are handled.—United States Rubber Company

270 **Automatic coupling** eliminates heat problem: metallic shoe conducts heat away from drum. Other features are elimination of torque fade and greater heat dissipation on high-inertia jobs.—O S Walker Company, Inc

271 **Taper-bored** flexible couplings afford easy fastening to shaft with firmness of shrunk-on fit. Six sizes range from 22 to 150 hp at 1750 rpm.—Lovejoy Flexible Coupling Company

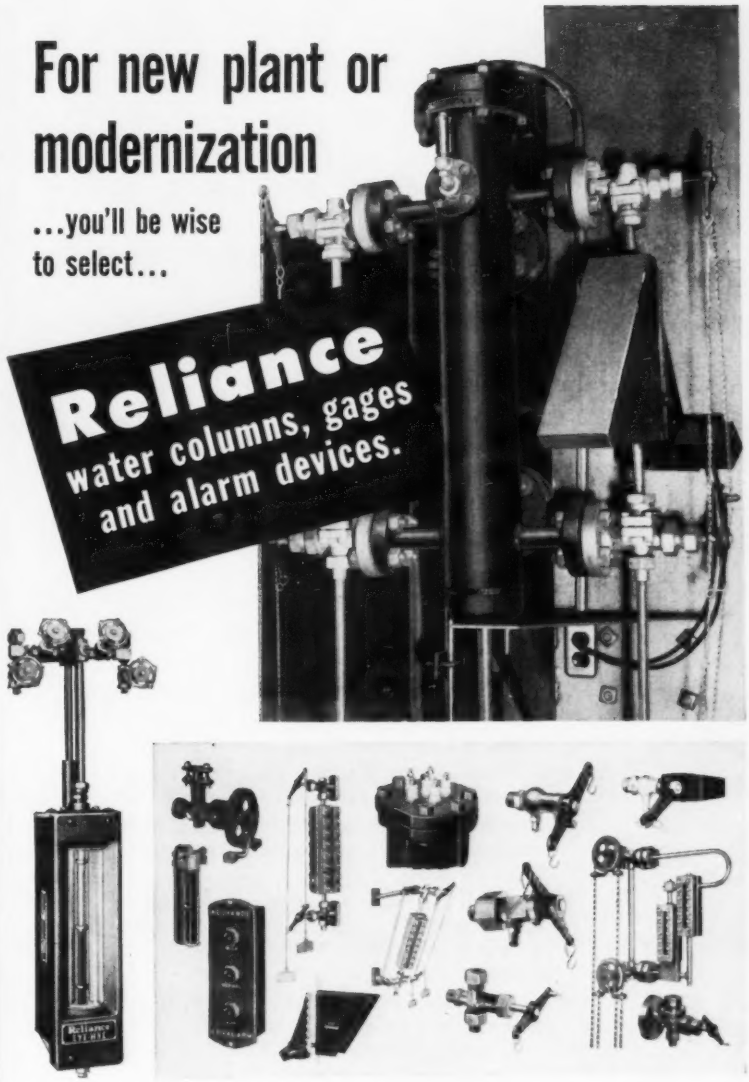
272 **Ball bearings** have lubrication sealed in to last their lifetime. Teflon seals provide contact between inner raceway and metal shields, prevent dirt from reaching working surfaces. — Hoover Ball and Bearing Company

(*Continued on page* 286)

For new plant or modernization

...you'll be wise to select...

Reliance
water columns, gages and alarm devices.



Plan wisely for completely safe water level supervision on all boilers, and all water-containing vessels, with rugged, efficient Reliance equipment. This specialized line includes water columns for any type of boiler—*any pressure*—and complete trim, including various types of gage inserts, direct-to-drum assemblies and illumination; remote gages, auxiliary alarms and automatic controls.

Known the world over for accuracy, sturdiness and dependability, Reliance equipment brings you the advantages of trouble-free low-maintenance service. For keeping your plant in the best of trim now, or for planning new or revised power facilities, keep posted on the latest in Reliance Boiler Safety Devices.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

For more facts circle 912 on Reader Service Card p 222

1500 miles of Spiralectrodes in Precipitator Service!

That's real proof of superior performance. Over 1500 miles of these emitting electrodes have been installed in 'SF' electric precipitators . . . delivering 50 to 100% more electron emission than conventional types of electrodes.

There are sound reasons why Buell *Spiralectrodes* are providing superior emitting efficiency in actual dust collecting applications.

- *Spiralectrodes* are *"emission engineered"* — pitch and diameter are custom designed for each application . . . of critical importance with high resistivity dust.
- *Spiralectrodes are precision made from stainless steel*— of uniform quality, corrosion-resistant.
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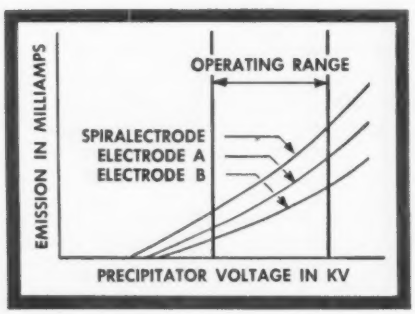
- *Spiralectrodes maintain predetermined tension* — (no weights required) . . . dampen effect of vibration caused by electrical pulsation, thereby minimizing electrode breakage.
- *Spiralectrodes'* controlled area emission stops sparking effect of "point emission."



Above chart illustrates the superior emission of the Spiralectrode: its corona voltage is lower and its emission is higher than other types of emitting electrodes over the entire operating range of industrial precipitator voltage.

The superior operating characteristics of Spiralectrodes contribute to continued high efficiency of Buell 'SF' Precipitators. Detailed information of this and other exclusive features are described in a booklet, "Buell 'SF' Electric Precipitators." Send for your copy: write Dept. **50-J**, Buell Engineering Company, Inc., 123 William Street, New York 38, New York.

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Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS

For more facts circle 913 on Reader Service Card p 222

MECHANICAL TRANSMISSION

Begins on page 282

MECHANICAL POWER TRANSMISSION BULLETINS: To get free copies of those you want circle key numbers on Reader Service Card provided on page 222

657 **Roller chains** and sprockets is title of 154-p book 2657. Written to serve as a practical text on use of roller chain for both power transmission and conveyor service, the book contains typical installation conditions, formulas, charts, diagrams to simplify selection of proper chains for any application. Link-Belt Company

658 **Speed reducers,** double-reduction in ratios from 75:1 to 4900:1, are covered in 20-p catalog CD230. Cone-Drive Gears, Div of Michigan Tool Company

659 **Power transmission,** conveying, elevating products are discussed in catalog 610. Gives selection data. Chain Belt Company

660 **Transmission products** and their uses in elevating and conveying machinery are described in 88-p catalog 914. Includes data on shaft collars, couplings, clutches, other equipment. Jeffrey Manufacturing Company

661 **Bearings,** pillow block mounted, are detailed in 8-p bulletin A668. Dodge Manufacturing Corporation

662 **Control rod** drive mechanism is covered in Q&A form in 10-p bulletin. Alco Products, Inc

663 **Magnetic drives** are discussed in 8-p booklet. Includes operating curves, selection charts. Whitney Chain Company

664 **Dry fluid drives** and couplings are described in 24-p bulletin A640B. Contains selection charts, thermal capacities. Fully illustrated. Dodge Manufacturing Corp

665 **Speed reducers,** double-, triple- and quadruple-reduction units, are detailed in 6-p folder 2651A. Link-Belt Company

666 **Worm gearing** is topic of 8-p bulletin 150. Provides design, manufacturing facts. Cleveland Worm & Gear Company

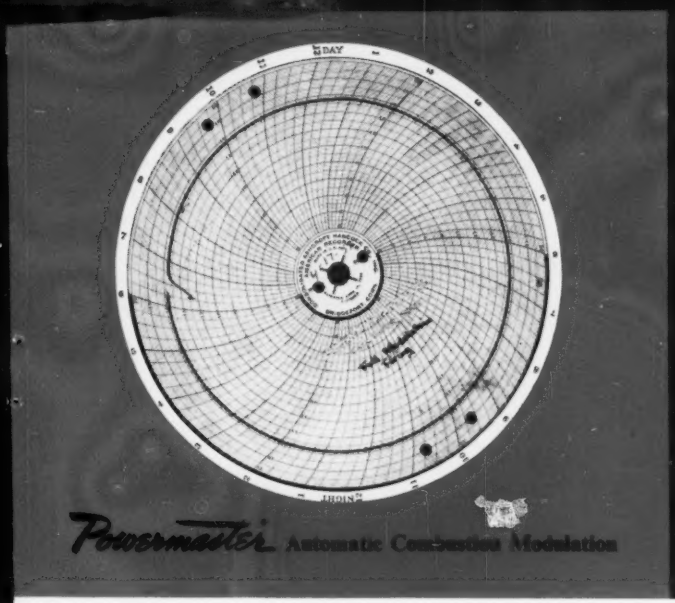
667 **Screw-conveyor drives** are covered in 8-p bulletin A667B. Dodge Manufacturing Corporation

668 **Silent chain drives** are subject of 88-p book 2425. Contains tables of service factors, ratings, chain length. Link-Belt Company

669 **Selective-speed drives** are detailed in 8-p bulletin 11-1. Century Electric Company

670 **Shaft-mounted drives** are listed in 8-p bulletin. Covers higher-ratio units. The Falk Corporation

(*Continued on page* 288)



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Ordinary On-Off Burner Operation

To get cost-saving uniform constant steam pressure

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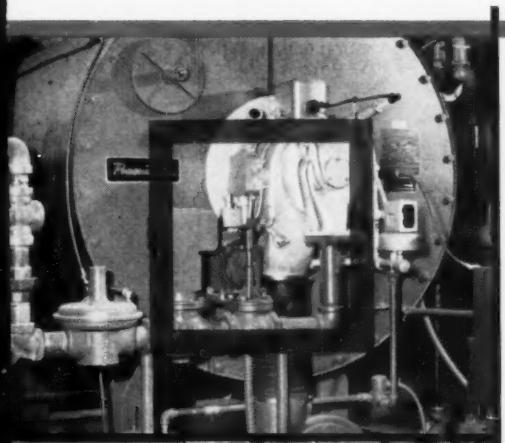
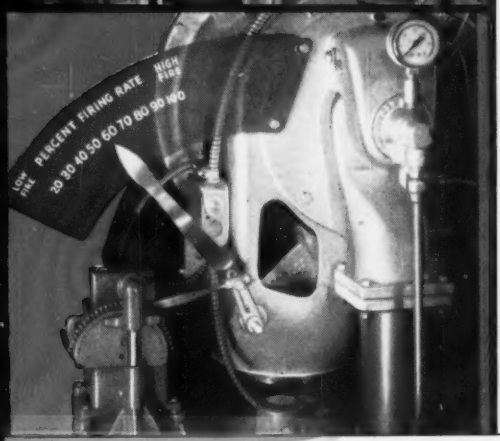
with full-range modulating firing control





Only *Powermaster* gives you the cam arrangement, air shutter linkage and motor operated fuel control valve that provides *full-range modulating firing control.* The difference is easy to recognize . . . you'll see it in uniformity of pressure and temperature as compared in charts, like above; you'll notice it in fuel bills reduced by *Powermaster* efficiency; you'll see it in better product quality and higher production; you'll see it in new boiler dependability at loads from 100% down to 20%.

Find out how (and why) O&S *Powermasters* consistently outperform boilers with ordinary on-off operation . . . save fuel dollars, efficiency dollars and maintenance dollars. Call in your O&S representative or write for the descriptive *Powermaster* bulletin. Orr & Sembower, Inc., Reading, Pa.

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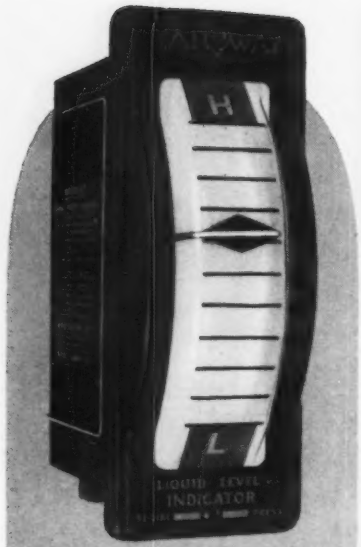
POWERMASTER/Models 3, 4 and 5 . . . POWER-PAK and BURNERS

For more facts circle 914 on Reader Service Card p 222



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288 circle 915 on Reader Service Card p 222

MECHANICAL TRANSMISSION

Begins on page 282

671 **Variable-speed drive** and pneumatic-control systems are covered in 8-p bulletin F-1882. U.S. Electrical Motors, Inc

672 **V-belt drives** to solve power-transmission problems are treated in 108-p book A661. Covers standard variable-speed and special-drive models. Tables give hp capacities, belt speeds. Dodge Manufacturing Corporation

673 **Worm gear drive** for stokers is subject of illustrated bulletin. Laclede Stoker Company

674 **Worm gear** speed reducers are discussed in 40-p booklet J13. Describes units from 0.1 to 121 hp. Hewitt-Robbins, Inc

675 **Worm gears,** double-enveloping type, are topic of 8-p bulletin CD-575. Cone-Drive Gears, Div of Michigan Tool Company

676 **Belting** for power transmission is subject of illustrated 10-p bulletin. Extremultus, Inc

677 **Shaft-mounted drives** are detailed in 32-p bulletin 7100. Includes selection tables, installation photos. The Falk Corporation

678 **Flexible couplings,** continuous-sleeve type, are described in 4-p bulletin 502. Zurn Industries, Inc

679 **Flexible gear couplings** are covered in 20-p catalog C-5. Gives design, application, lube data. Sier-Bath Gear and Pump Co, Inc

680 **Cushion coupling** is subject of 12-p bulletin A669B. Full-view photos, cutaway drawings show construction of flexible unit. Dodge Manufacturing Corporation

681 **Flexible couplings** for 150 service applications are topic of 8-p bulletin 10100. T B Wood's Sons Co

682 **Couplings** are topic of 12-p bulletin C210A. Includes sizes, specs of die-cast, steel, fixed-bore, bushed types. Browning Manufacturing Company

683 **Gearmotors** and packaged drives are described, illustrated in 8-p bulletin DB-3650. Westinghouse Electric Corporation

684 **Ball, roller bearings** are among products described in 88-p catalog AG-57. Includes engineering-data section, specs on ball-thrust bearings, washers, retainers, clutch-release bearings. Aetna Ball and Roller Bearing Company

685 **Pulley lagging** is subject of 4-p bulletin. Gives application methods. Condersite Engineering Corp

686 **Steel hubs** and malleable split taper bushings are subject of 4-p bulletin HB-101-A. Browning Manufacturing Company

thermocouple extension wire in

MULTIPAIR CABLE

it cuts installation costs

When four or more pairs of thermocouple extension wires are needed, SERV-RITE thermocouple extension cable will reduce installation costs several ways. It takes considerably less time compared to pulling individual pairs of wires through conduit. Cable also permits the use of much smaller conduit than for the same number of individual wires. It can be hung without conduit, or installed in open trough or by direct burial.

The cable, as well as each conductor, is color coded. Also, each pair of wire is marked for quick identification.

Cables with multiple pairs of four or more conductors of the commonly used types are carried in stock.

Write for Bulletin No. 1200-3
for specifications and data on SERV-RITE thermocouple extension cables.

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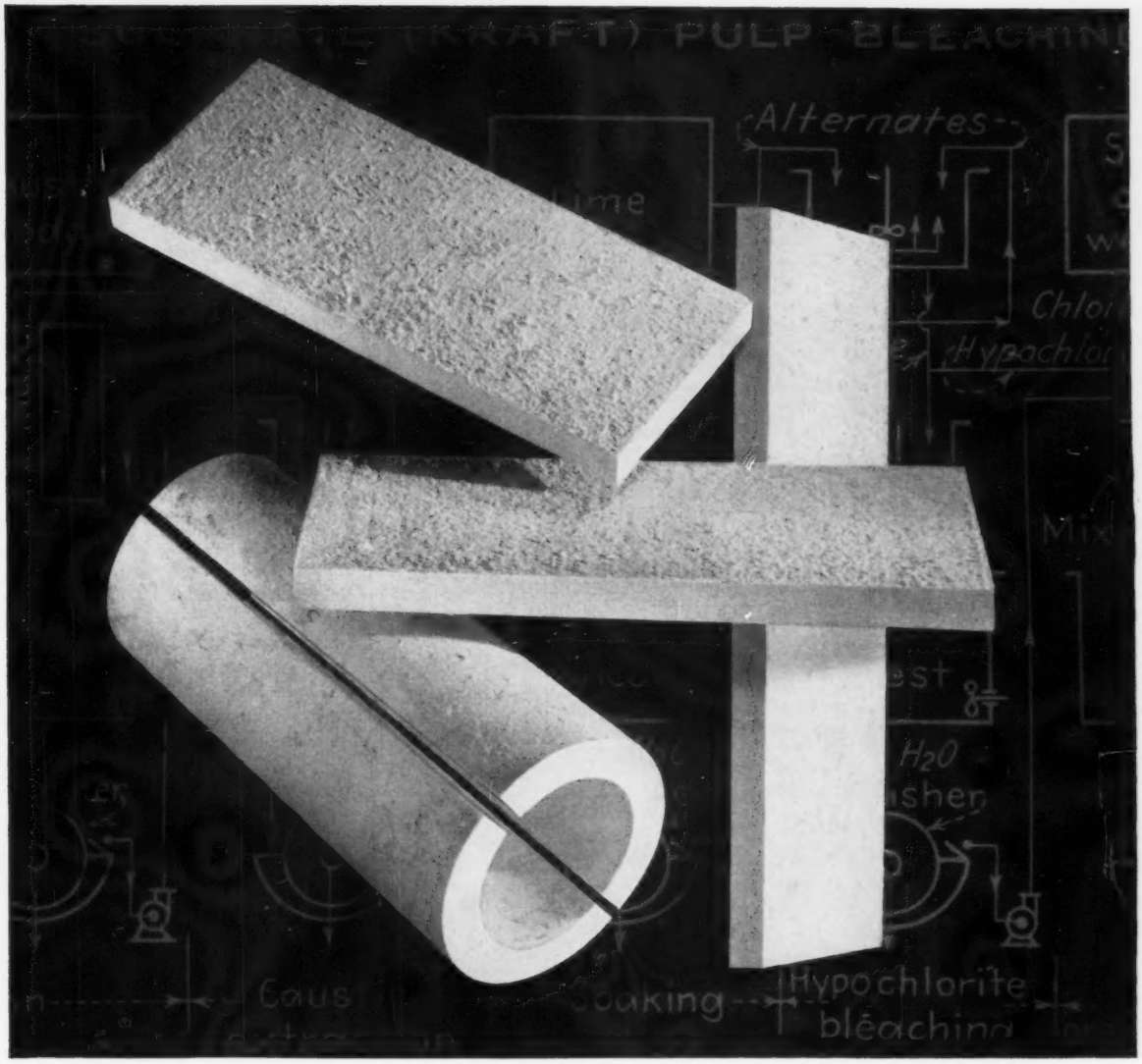
For more facts circle 914 on Reader Service Card p 222



For paper pulp refining as in other operations, "K&M" High-Pressure Insulations provide durable, economical heat control.

Your customers get more heat from every ounce of fuel with "K&M" High-Pressure Insulations!

Minimize installation time and costs, and be sure of customer satisfaction. How? With "K&M" High-Pressure Insulations.

Maximum fuel efficiency, minimum fuel costs, and more precise process control—that's what you offer your customers with "K&M" High-Pressure Insulations. They last the lifetime of the equipment. Tame temperatures of up to 1900° F. Withstand temperature changes, vibration, and moisture.

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For temperatures up to 1900° F., use "K&M" Hy-Temp Combination—diatomaceous silica overlaid with "K&M" "Featherweight" 85% Magnesia. Staggered joints prevent heat loss from expansion-caused openings.

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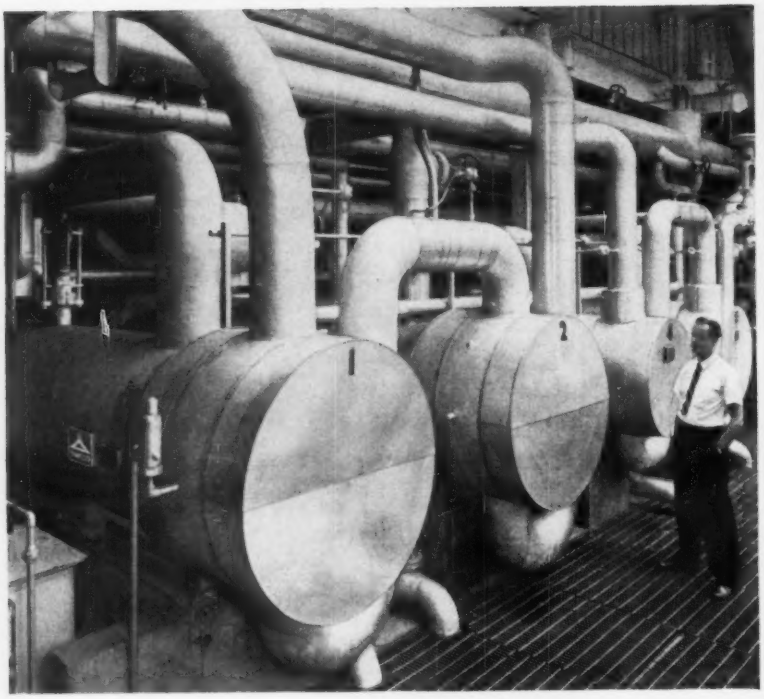

Four SWECO feedwater heaters (two high-pressure and two low-pressure) in 44,000 KW unit at Broadway Steam Plant, Light and Power Department, Pasadena, California

No concern – about these seal-welded feedwater heaters

Continuous trouble-free high pressure operation assured by SWECO's exclusive "pre-stressed welding".

The channel closure of every SWECO high-pressure feedwater heater is seal-welded under pressure – half again as great as the designed operating pressure. Thus, when the unit is delivered and placed in actual operation, the stress in the closure weld is largely eliminated, providing trouble-free performance throughout the heater's long service life.

The two high-pressure feedwater heaters in the Pasadena plant (left in photo above) were even installed without shutoff valves or bypass, because department engineers decided that the reliability of SWECO all-welded heaters is greater than that of valves. The units have now been in continuous operation more than a year – with load swings between 10,000 and 20,000 KW, 5 to 10 times a day – with corresponding variations in pressure and temperature – but with no trouble, no concern.

For your copy of the new bulletin on exclusive pre-stressed welding process and other quality features of SWECO feedwater heaters, write for Bulletin M-11-393.

More than 40 years service to the process and power industries.

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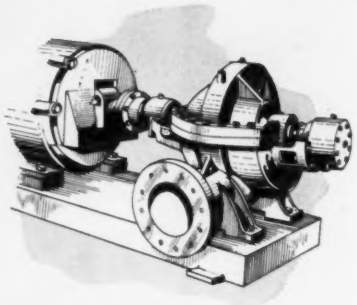
PUMPS and COMPRESSORS



Never before have pumps been put to as severe service as they are today. Coping with high-pressures and temperatures, corrosive materials, high heads is all part of their day's work. To cut maintenance, some pumps are of packless design; others have mechanical seals rather than jam type packing. So-called "canned" pumps with no seal of any kind are part of the pumping picture. Now, an entirely new principle shows up—the "sonic" pump. Presently used for oil wells, it has also been tested for water, slurries, chemicals, etc. An oscillator causes the tubing to vibrate up and down in the well. Only other moving part is the foot valve. This pump normally operates from 600 to 1200 strokes, or cycles, per minute. At present they lift liquids from wells that are up to 1500 ft deep.

Stan Elonka

Associate Editor

RECENT PUMP and COMPRESSOR EQUIPMENT: To get complete information, circle the key numbers on Reader Service Card provided on page 222

273 **Design improvement** of 2-stage vacuum pump, used for steam-turbine condenser service, results in shorter, simpler construction than previous model. Motor has been moved from middle of set-up to the end. Thus, a standard single-shafted motor of open or closed design can be used. Simplified piping for interstage connection is more compact. Moisture separator on the interstages and interstage water alarm have been eliminated.—Allis-Chalmers Manufacturing Company

274 **Controlled-volume** positive-displacement pumps are highly accurate for metering chemicals to boiler feedwater. Latest addition

For more facts circle 918 on Reader Service Card p 222

How to beat the high cost of temperature control

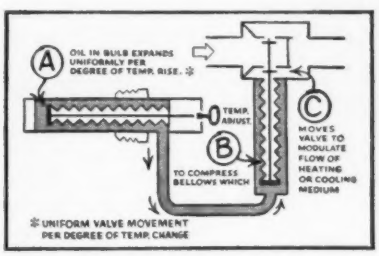
The practical approach to temperature control

By John W. Ritter, Test Engineer, SARCO Company, Inc.

Precise temperature regulation is essential in many processing operations, not only for quality control, but for maintenance of output as well.

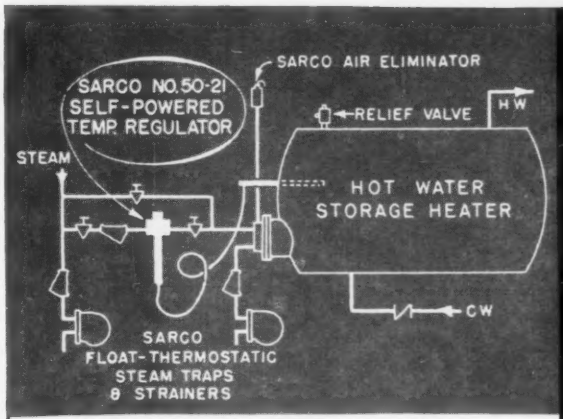
Manual temperature control is unsatisfactory because of the possibility of spoilage and loss of quality control which can result from irregular or indifferent hand regulation.

Automatic controls are available in a wide variety, including pneumatic, electronic, and self-powered. Pneumatic and electronic controls are relatively expensive to purchase and install, and may require frequent maintenance. However, in most applications, control requirements can be achieved very successfully by the use of relatively simple, economical Sarco Self-powered Regulators.


A
OIL IN BULB EXPANDS UNIFORMLY PER DEGREE OF TEMP. RISE. *
TEMP. ADJUST
B
TO COMPRESS BELLOWS WHICH
C
MOVES VALVE TO MODULATE FLOW OF HEATING OR COOLING MEDIUM
* UNIFORM VALVE MOVEMENT PER DEGREE OF TEMP. CHANGE

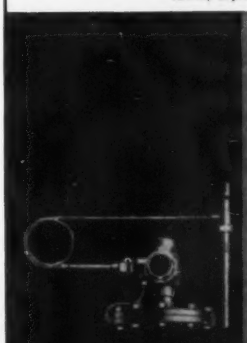
This drawing shows simplicity of operation of the Sarco 50-21 Temperature Regulator, which consists of a thermostat, capillary tubing, and a valve.

Sarco controls, like the 50-21 and the 24-30, have the required degree of sensitivity and dependability, combined with the ruggedness inherent in the sealed capillary tube construction. Because these Sarco controls do not depend on external power, such as electricity or compressed air, they have established long records of sustained, reliable operation. They are an economical and practical solution to the problem of maintaining continuous watchdog duty over processing temperatures.

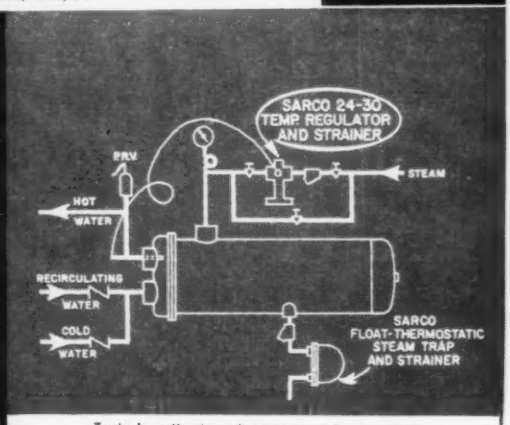


Typical applications: hot water storage heaters, shell and tube heat exchangers, condensers, oil storage tanks, dryers, kilns, etc.

Sarco Type 50-21 Self-Powered Regulator.



Sarco Type 24-30 Self-Powered, Pilot Operated Regulator.



Typical applications: instantaneous heaters, fuel oil preheaters, and all dead-end service applications.

Self-powered automatic temperature regulators by SARCO . . .

have these 5 marked advantages: No compressed air or electrical wiring required. No delicate mechanisms to adjust or maintain. No packing glands to stick or require maintenance. No shutdown during power failure. No specialized maintenance required.

Sarco Self-Powered Controls are self-contained and can be installed by any pipe fitter. They are so reasonable in cost that you can afford Sarco automatic heating controls for every application in your plant. Write for 10-page Sarco Control Bulletin No. 620.

6346-B

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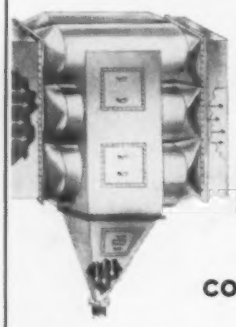
STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

For more facts circle 919 on Reader Service Card p 222

REGENERATIVE



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★ Removes Fly Ash, Soot and Cinders from Stack Gases

★ For Natural or Induced Draft

★ High Efficiency at All Loads

★ For All Plant Arrangements and Sizes

Write for Bulletin F

BRESLOVE SEPARATOR COMPANY

COMMONWEALTH BUILDING
PITTSBURGH 22, PA.

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Safe Operation of Overhead Valves

with a

Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

- Simplifies pipe lay-out
- Fits any size valve wheel
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- Operates any valve from plant floor
- Time and money saving fixture
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- Packed, completely assembled, one to a carton
- Hot galvanized, rust-proof chain available for all sizes
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Babbitt STEAM SPECIALTY CO.

2 BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

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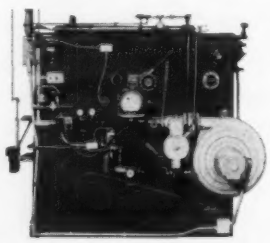
You Read About it in the "SPECIAL REPORT ON PACKAGED BOILERS"
— "POWER MAGAZINE", August, 1958

NOW GET CALOREX BURNER PERFORMANCE *Packaged*... JUST BOLT ON!

Automatic firing of *any grade* of fuel oil...guaranteed combustion performance of 12½% CO_2, without smoke...fast, simple changeover to gas when more economical...labor savings that result from complete boiler room automation...

These are some of the Calorex advantages now easily available in CALOREX PLANNED-PACKAGE BURNERS. Standard models for practically every requirement of power and steam generation — heating — hot water — steam operated floating or mobile equipment.

Let our engineers guide you in obtaining the exact model for top economy in your plant. Write today!



Fuel oil costs were cut nearly 1/3rd during the first year of operation of this Model R-200 Calorex Planned-Package Burner at a large uniform laundry-rental plant. Model made in two designs for both fire-tube and water-tube boilers.

CALOREX *planned-package* BURNERS

W. N. BEST COMBUSTION EQUIPMENT COMPANY
413 11th Street • Carlstadt, N. J.

to line is 1/16-in.-dia plunger model, reported to provide all advantages of other miniPump units for metering capacities as low as 3 ml per hr with accuracy of better than ±2%. Metering against pressures to 1000 psi, they have micrometer adjustment of stroke length, and can be equipped with control devices for automatic capacity changes in response to electrical or pneumatic control signals.—Milton Roy Company

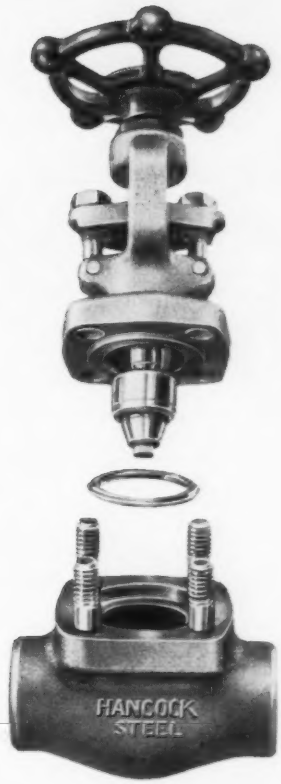
275 **All-aluminum pump** for construction, utility application weighs 49¾ lb in 1½-in. size, 52½ lb in 2-in. model. Self-lubricating mechanical-shaft seal, improved diffuser system are two features. Cover plate may be removed quickly for inspection.—Marlow Pumps, Div of Bell & Gossett Co

276 **Rotary pump** offers high efficiency up to 1200 gpm. Applications include transfer, metering of viscous and thin liquids, other services involving pressures to 100 psi. Minimum sealing surfaces with optimum rotor and idler dimensions for any given viscosity are reported to reduce drag, give efficiencies to 90%. Flow may be reversed regardless of shaft rotation.—Seren Machine Products Corporation

277 **Small, chemical** pump-motor unit has capacities to 16 gpm, heads to 28 ft. It is designed for heavy-duty continuous operation with any equipment requiring corrosive liquid circulation. Made of stainless-316, it is of standard volute type centrifugal design. Suction and discharge connections take standard ¾-in. piping.—Goulds Pumps, Inc

278 **Portable pump** develops 10,000 psi, delivers 80 cu in. of oil per min. Driven by a standard ½-hp 1750-rpm motor, unit can be used with hydraulic benders, pipe pushers, knockout punches or for pressing, pushing or pulling bushings, bearings, shafts, pump pistons.—Tal Bender, Inc

279 **Chemical pump** injects measured amounts of liquid chemicals into flow lines and pressure vessels against pressures to 1200 psi. It is operated by a ¼-hp 1750-rpm motor. A 50:1 reduction worm-gear assembly runs crosshead drive mechanism to move piston

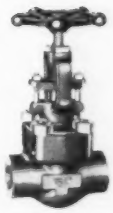


NEW VALVE-OLOGY

shuts off costly maintenance

Hancock 600# Steel Valves incorporate new concepts in valve-ology that reduce valve maintenance and equipment down-time. The forged steel bonnet and body have butting flanges so strong no distortion is possible. The flanges form a bonnet joint that utilizes the sealing power of a Flexitallic* gasket so effectively not even pressures exceeding ten times the rating of the valve can cause a blowout.

Hancock valve-ology makes full use of stainless steel to reduce your valving cost. Seat, disc, stem, swing bolts and nuts, thread bushing, packing gland follower—all are stainless steel. Globe, Angle, "Flocontrol", Lift Check, and Hi-Pressure Drop designs available. A high degree of standardization simplifies servicing and inventory needs. Your industrial supply distributor will gladly give you full details on Hancock Valve quality and performance. Phone him today.



Hancock 600# Steel Globe Valve. Type 5500 Line. Sizes: ¼" thru 2".

*Trademark of Flexitallic Gasket Company

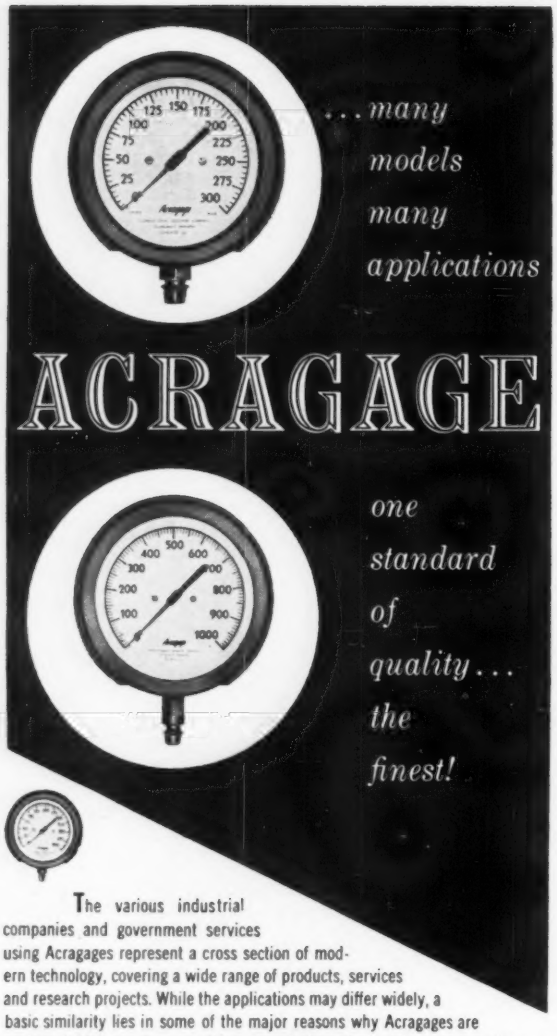
HANCOCK STEEL VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Watertown, Massachusetts
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

For more facts circle 923 on Reader Service Card p 222



The various industrial companies and government services using Acragages represent a cross section of modern technology, covering a wide range of products, services and research projects. While the applications may differ widely, a basic similarity lies in some of the major reasons why Acragages are preferred: high accuracy, precision manufacture, fast and easy calibration, built-in safety, and assured dependability.

Acragages are the most advanced of the bourdon tube type pressure gage. Besides high accuracy, they feature solid front cases providing complete safety as well as quick and easy access to the bourdon tube assembly and internal mechanism for easy calibration. This solid front case feature is standard with Acragage . . . only one of a number of advancements typifying Acragage's development policy.

ACRAGAGE GIVES YOU MORE GAGE PER DOLLAR

- VACUUM GAGES
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injectors. Output may be preset to inject from a few oz to 40 gal in a 24-hr period.—Texstream Corporation

280 **Submersible pump** can cope with up to 20% solids, is adapted for filter-screen sump service and supplying river-water intake for industrial plants. It operates partly or completely submerged. Built-in thermostatic cutoff protects motor against damage from overheating. Automatic reset starts pump when obstructions are removed. Squirrel-cage, 3-phase 60-cycle motor is rated 7½ hp, operates in factory-sealed oil bath. —Sumo Pumps, Inc

281 **High-capacity** oil-diffusion booster pump with 12-in. inlet produces pumping speeds between 5200 and 6000 cfm at pressures from 0.8 to 5 microns mercury. Forepressure tolerance of 900 microns makes booster useful for installation in series with high-vacuum diffusion pumps where maximum gas-handling capacity is required. —NRC Equipment Corporation

282 **General-purpose pump** comes in close-coupled and pedestal-mounted horizontal, flange- and base-mounted vertical models. Sizes range from ¼ to 40 hp at 3500 rpm, ¼ to 20 hp at 1750 rpm. Designed for circulating, coolant, cooling-tower applications, they have low npsh characteristics to meet critical suction conditions. Interchangeable inserts give quick packing-to-seal changeover.—Aurora Pump Division, New York Air Brake Company

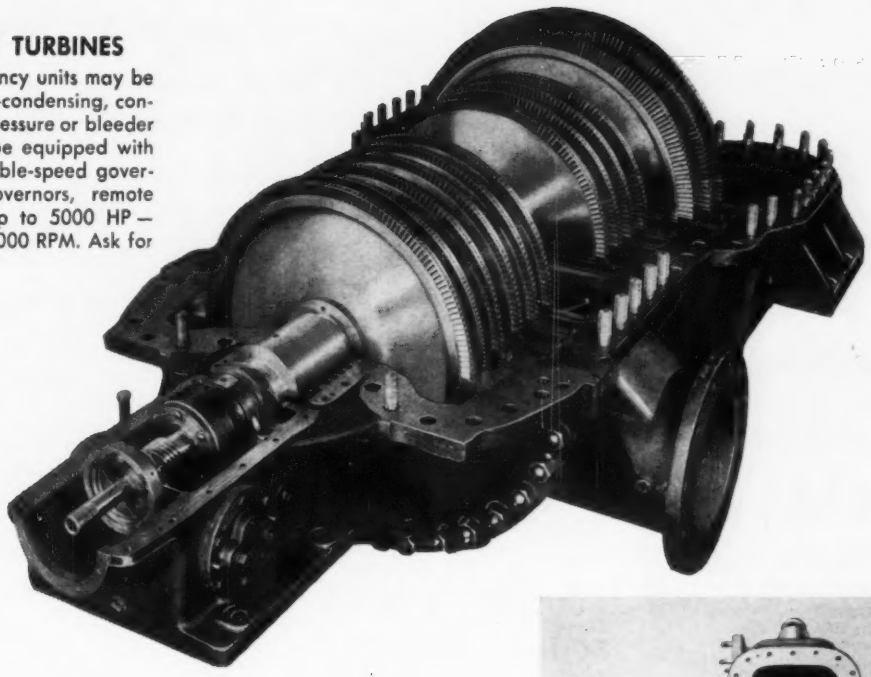
283 **Slurry pump** handles 2¼ to 15 gph when directly connected to a ¼-hp 1725-rpm motor, pumping against 100 psig. Result: Proportion of solids in the mix tank can be kept constant while amount of solids delivered can be varied by pump's stroke adjuster. — Manzel Division of Houdaille Industries, Inc

284 **Diaphragm liquid end** is mated with existing packed-plunger pump to handle controlled-volume jobs involving highly corrosive, toxic or obnoxious chemicals. Diaphragms are of Teflon with diameter and thickness test-selected so stresses on diaphragm are safely within fatigue limits. A monel corrugated filler ring ab-

For more facts circle 924 on Reader Service Card p 222

MULTI-STAGE TURBINES

These high-efficiency units may be designed for non-condensing, condensing, mixed pressure or bleeder operation. Can be equipped with constant or variable-speed governors, special governors, remote controls. Sizes up to 5000 HP — Speeds up to 10,000 RPM. Ask for Bulletin S-146.



There's a **Terry turbine** for every mechanical-drive requirement

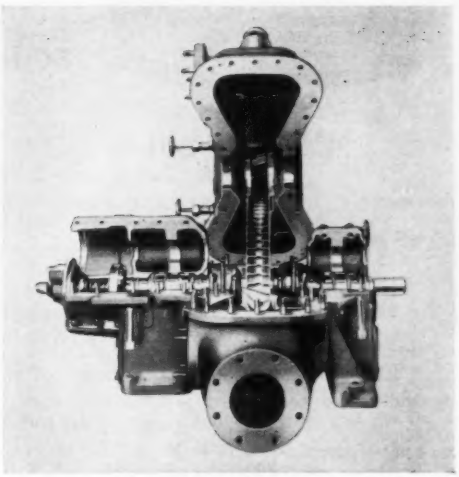
The designs for Terry turbines are based on more than 50 years of successful experience in the manufacture of turbine drives *exclusively*. This specialization has resulted in Terry becoming one of *the leading producers* of mechanical-drive turbines in sizes up to 5,000 horsepower.

There are three basic reasons why Terry has been able to maintain this position of leadership: (1) a thorough knowledge of the requirements of mechanical-drive turbines, (2) a willingness to build "a little something extra" into each machine to assure trouble-free operation, and (3) an acknowledgement of the company's responsibility to stand behind the performance of every turbine sold.

These are also the reasons why you should consider a Terry turbine for your next mechanical drive. In the meantime, send for bulletins describing any of the types of machines illustrated.

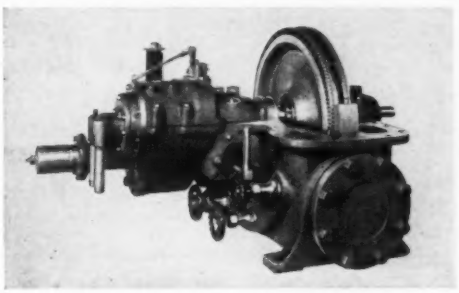
THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



SOLID-WHEEL TURBINES

Famous for sure dependability and ease of inspection. Can be started cold — no preliminary warming required. Available in vertical designs depending on frame size. Capacities from 5 to 2,000 HP. Described in Bulletin S-116.

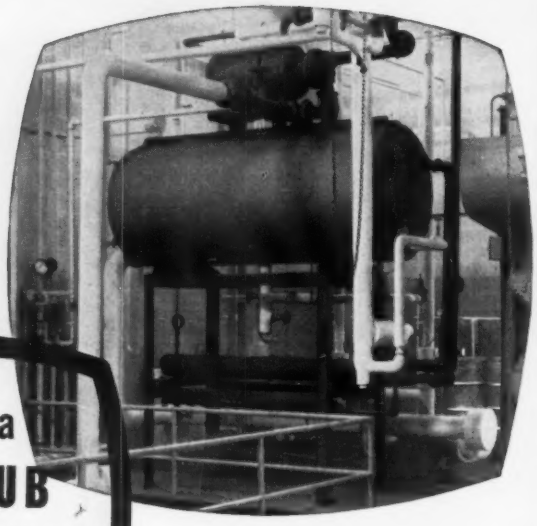


AXIAL-FLOW IMPULSE TURBINES

Built with one, two or three rows of high-grade stainless steel blading, these turbines combine efficiency with durability. Available in designs for moderate and high steam pressure. Bulletin S-143.

TT-1209

For more facts circle 925 on Reader Service Card p 222



with a **SCHAUB** ZERO-OXYGEN DEAERATOR

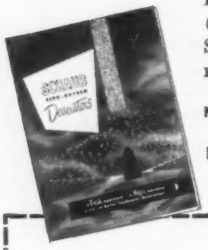
you DON'T NEED sodium sulphite!

True boiler system corrosion protection ...oxygen removal to .005 cc/liter actually achieved under all load variations

The plain fact is, if you have to add something like sodium sulphite to a deaerator for final scavenging of oxygen, you just aren't getting full deaeration. (And you *could* get some bad side effects, worse than the oxygen itself.)

The unique Schaub principle employs 1) external "superheating" to *above* boiling point in the deaerator . . . 2) "explosive" flash-down to release all dissolved gases . . . and 3) fully vented operation. This completely eliminates the air-fill problem and *thermal efficiency compromise* common to all conventional design deaerators using internal heating and restricted vent. *For you* this adds up to *actual* "zero" oxygen removal (to .005 cc/liter) with excellent thermal efficiency under wide load variations — with no need for "additives"

Further, it's a simple, *fully safe* system that takes less maintenance and attention, requires less head room, has fewer internal parts, and no "pressure shell" *insurance premiums to pay.* And exclusive Chromasoid lining guarantees against shell corrosion failure for 10 years!



For new installations or added deaerating capacity (up to 125,000 lbs./hr.) get the facts on the SCHAUB Zero-Oxygen *now* — from your Schaub representative or Write for Bulletin 575.

MAIL THIS COUPON FOR FREE DATA BOOK . . .

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Please send me without cost or obligation my personal copy Bulletin 575 on Boiler Feedwater Deaeration theory and practice.

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Begins on page 290

sorbs compression of bolting the diaphragm head to displacement chamber. It provides a leakproof seal without subjecting diaphragm to squeezing action that would produce cold flow and possible attendant deformity and leakage.—Milton Roy Company

285 **Steam jacketing** has been added to all sizes, constructions of company's Fig. 3715 pumps for 100-psig steam or 38-F saturated steam. Jacketing is of fabricated steel, asbestos gasketed, and is bolted to remachined casing cover. Savings in power, process water or product are reported result of raised temperature.—Goulds Pumps, Inc

286 **Teflon diaphragm** pump proportions, meters fluids at pressures to 2500 psi. Pump features packless design, capsulated construction, minimum maintenance, continuous flow in a wide output range. —Hills-McCanna Company

287 **Portable pump** tackles muddy or sandy water, handles flows to 7000 gph. Large-passage open impeller is reported to provide clogless operation. Unit weighs 54 lb, is powered by a 2¾-hp 4-cycle motor with built-in exhaust valve rotator.—Hale Fire Pump Company

288 **Submersible pumps** in rugged cast-bronze construction have increased capacity to 5000 gph at 10-ft head with a 30-ft shutoff head. Compact design combines high torque output of ½-hp motor with a direct-drive nonclogging pump impeller, uses a new ceramic seal-seat mounted on impeller back to completely seal motor shaft from fluid being pumped. Applications include dewatering of transformer vaults, utility tunnels, elevator pits, basements, etc.—Kenco Pump Division of The American Crucible Products Company

289 **Water-jet exhauster** has reduced water requirements, making it economical for high capacities. Units are suitable for (1) evacuating and priming a closed system before steam pressure is available at startup (2) handling noncondensables at low absolute pressure (3) mixing gases with liquids. In operation, water under pressure enters through inlet at

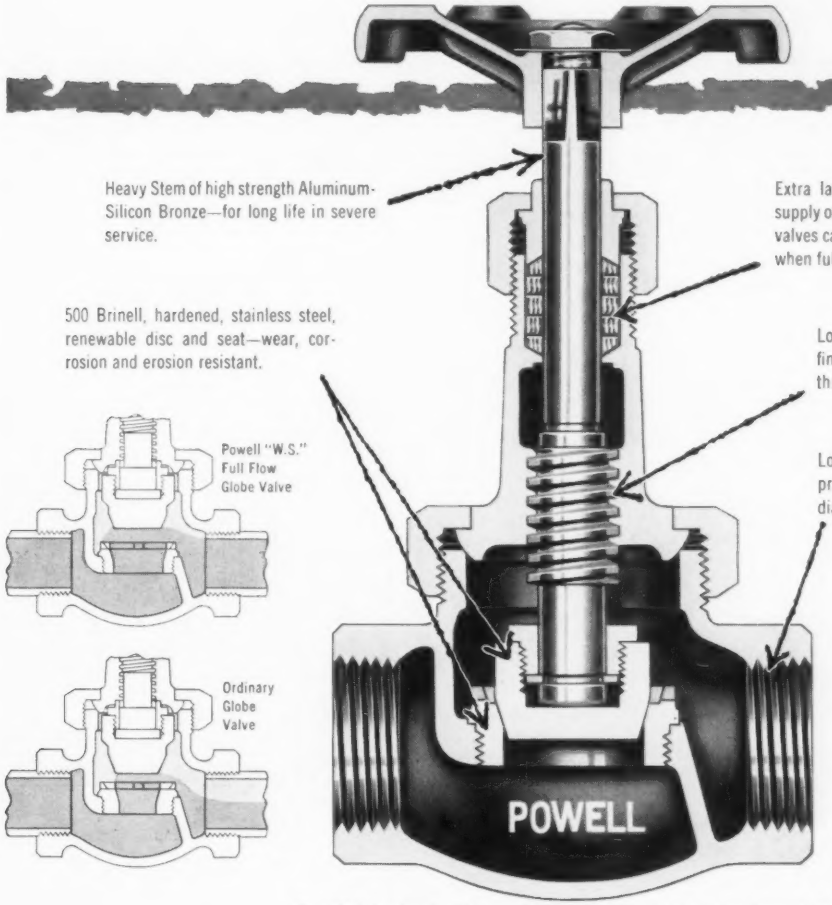
BULLETIN!

POWELL introduces new member in world's largest family of valves

Powell engineered "Full Flow" bronze valves are now available in a full line: the brand-new 150-pound screwed end Globe Valve, in addition to the well-known 200-300 pound Screwed and the 150-300 pound Flanged Globe and Angle Valves.

Although designed by Powell to assure maximum flow with minimum pressure drop and internal turbulence, these valves can be throttled to permit only the minutest amount of fluid to pass through. And, if desired, they can be supplied with Indicator Collar, Arm and V-port Disc for quickly determining flow and holding it constant.

Compare these advantages of Powell Full Flow valves:


Heavy Stem of high strength Aluminum-Silicon Bronze—for long life in severe service.
Extra large stuffing box holds ample supply of lubricated asbestos packing—valves can be repacked under pressure when fully open.
500 Brinell, hardened, stainless steel, renewable disc and seat—wear, corrosion and erosion resistant.
Long Acme Stem Threads have a fine pitch to easily regulate the close throttling and reduce thread wear.
Long pipe thread and thread run-off prevent jamming the pipe against the diaphragm and distorting the seat.
Powell "W.S." Full Flow Globe Valve
Ordinary Globe Valve
POWELL

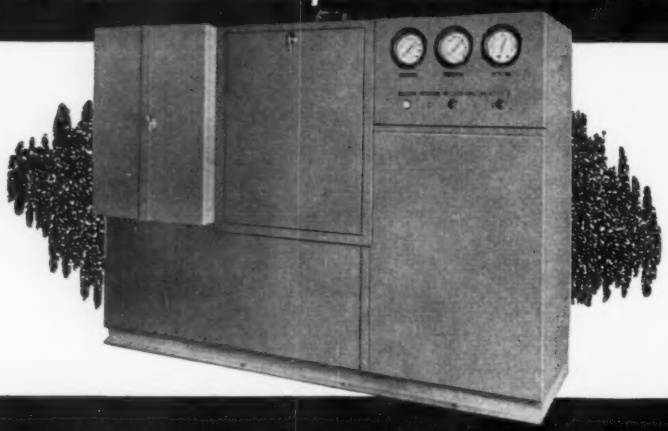
When you require precise flow control with minimum pressure drop and turbulence, little maintenance and long life, specify Powell Full Flow Valves. Consult your local distributor, or write us for illustrated literature.

Fig. 2600 (Sectional)—150-pound "W.S." Full Flow Globe Valve, Screwed Ends

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

For more facts circle 927 on Reader Service Card p 222

NOW - Steam Atomizing with NATIONAL AIROIL Packaged Firing Units FOR OIL AND/OR GAS FUELS



AUTOMATIC . . . ECONOMICAL . . . CLEAN . . . SAFE

● Fully Automatic ● Low Fire Start ● Electric-gas Ignition ● Modulating Fire Control ● Damper Sequence Control ● Forced Draft Combustion Air ● Electronic Combustion Safety Supervision ● Mechanical Atomizing — Steam assisted internal mixing oil burner ● Ring or Cylindrical type Gas Burner for gas fuel ● Fire tested before shipment.

NOW . . . with the new Series 20 Packaged Firing Unit you can have all the advantages of the outstanding Dual Stage burner in a completely packaged unit equipped with the latest in electronic safety controls to give *automatic* start, *automatic* modulation, *automatic* shutdown.

Series 20 Packaged Firing Units are factory fire tested, ready for immediate and low cost installation in your furnace room. They need only oil, gas, steam, draft and electrical connections—everything else needed for fully automatic burner operation is there.

Capacities of standard units range from 200 to 830 boiler horsepower. (7,200 to 30,000 pounds of steam per hour). Larger units are available on order to meet your special needs.

Units may be used with any standard boiler or furnace under natural or induced draft, or with pressurized boilers—in which case the unit provides sufficient forced draft to overcome draft loss through boiler. Where a high chimney or induced draft fan is used, an automatic damper motor is furnished to provide a constant furnace draft during operations; and a reduced or zero draft during shutdowns.

Preventative Maintenance consists chiefly of keeping the burner gun clean, with periodic inspection and cleaning of strainers and safety devices. This minimum maintenance will give your engineer or fireman extra time to attend to blow-down, soot-blowing, or to check operations and efficiency of plant and auxiliary equipment.

For complete details, specifications, illustrations, and dimensions write today for Bulletin No. 28.

When used in conjunction with a National Airoil Fuel Oil Pumping and Heating Unit (Bulletin No. 40) a most reliable combination results.

National Airoil BURNER COMPANY, INC.

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SOUTHWESTERN DIVISION 2512 SOUTH BOULEVARD, HOUSTON 6, TEXAS

Begins on page 290

top of unit, passes through nozzles, entrains air or gases through suction inlet at side.—Schutte & Koerting Company

290 **Single-stage** centrifugal compressor is now built in a barrel type casing, can operate at working pressure to 500 psia. By contrast, conventional single-stage units have a maximum working pressure of about 50 psia. Casing features consist of three principal parts: the casing cylinder, a bolted casing head and a fabricated bearing pedestal.—Allis-Chalmers Manufacturing Company

291 **Compact** air compressor occupies only 34 sq ft of floor space, needs no special base. The 200-hp 2-stage unit is available with tube type intercooler or self-contained radiator-intercooler. — Gardner-Denver Company

292 **Booster** and second-stage compressor unit has nine 4¼-in. stroke cylinders—six with 4⅜-in. bore, three with 3½-in. bore. Intercooler is inserted between the two stages. Unit is designed for low temperatures.—Frick Co

293 **Tank-mounted** rotary compressor line comes in 2-, 3- and 5-hp models, operating at 100 and 200 psi. Features reported are freedom from vibration, quiet operation, easy installation.—Davey Compressor Company

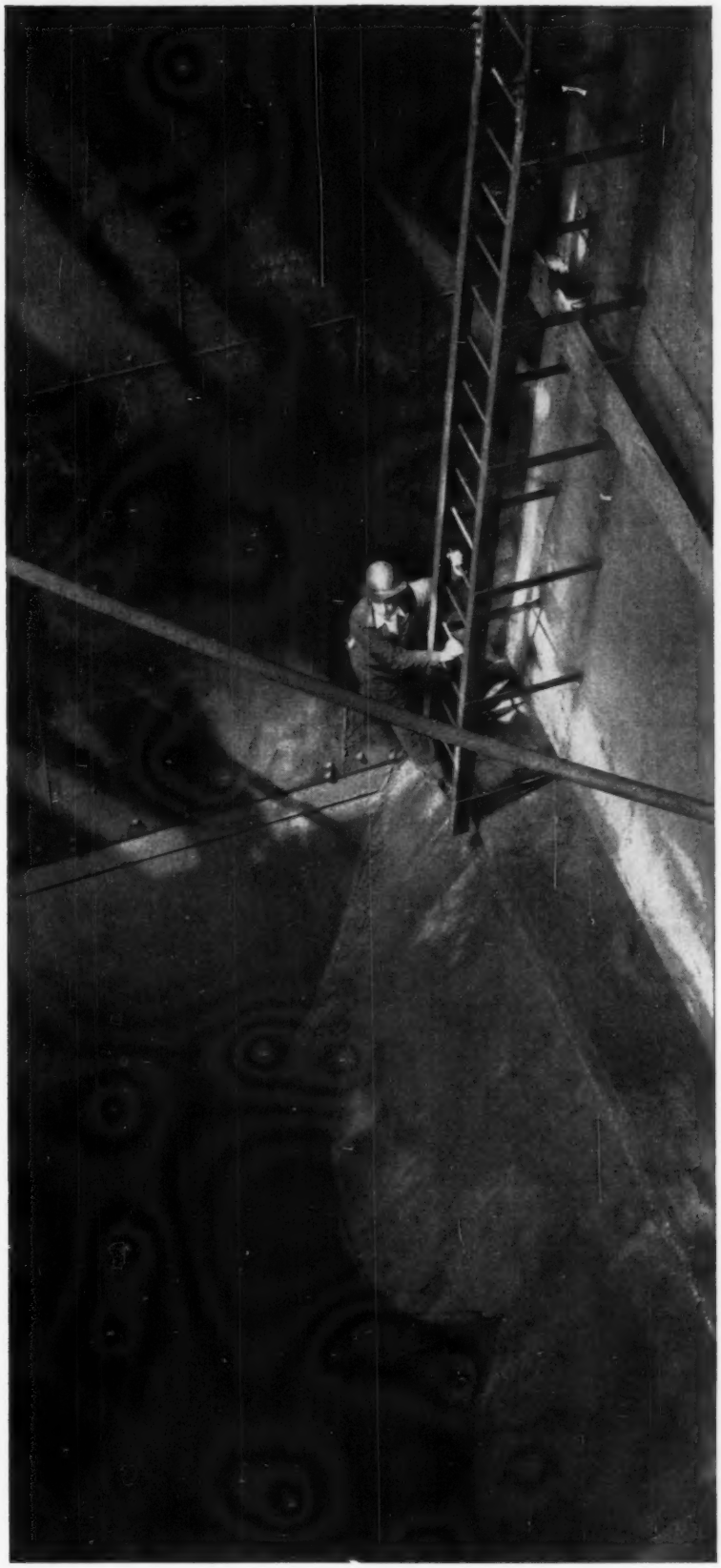
294 **Positive-displacement** rotary compressor is reported to combine efficiency of reciprocating machine with compactness of centrifugal unit. Standard capacity range of the 2-impeller helical-lobe axial-flow line is 800 to 13,000 cfm. Power is transmitted to secondary impeller through a cushion of compressed gas. Since there's no metal-to-metal contact, no impeller lube is needed. — Fairbanks, Morse & Company

295 **Twin-unit compressor** can run separately to deliver 600 cfm of free air at 100 psi, or together for 1200 cfm delivery. Since units are similar, parts can be interchanged for servicing. Dry weight is 14,700 lb; dimensions are 14½x8x8 ft. Powered by GM 6-71 diesel engines, modulation is separate or simultaneous.—Westinghouse Air Brake Company

(*New free bulletins, turn page*)

For more facts circle 928 on Reader Service Card p 222

Coal hoppers, chutes and liners are among the many applications in which USS "T-1" Steel has greatly increased service life.



How to **beef-up** your equipment without adding fat

Build it stronger, tougher and lighter with USS "T-1" Steel plates. This remarkable steel was developed especially to meet the need for bigger machines and stronger, more durable equipment, built larger but with lighter components.

"T-1" Steel's greater strength reduces weight. Furnished quenched and tempered to 100,000 psi minimum yield strength, USS "T-1" Steel plates permit designers to reduce the thickness of steel used for water turbine cases, penstocks, transformers and many supporting structures. Weight reductions of 25% to 50% are possible. This in turn cuts freight and welding costs and reduces foundation requirements. USS "T-1" Steel plates can still be furnished to 90,000 psi min. yield strength and 105,000 psi min. tensile strength to meet the requirements of ASME Code 1204-3.

"T-1" Steel lengthens service life. For maximum resistance to impact abrasion, USS "T-1" Steel is furnished quenched and tempered to 321 minimum Brinell. It is recommended for applications such as coal chutes, hoppers, pulverizer feed pipes, exhaust pipes and liners for ash collectors. Users report increases in service life up to 100% or more.

"T-1" Steel is weldable. It's unusual that a steel so strong and durable can be readily welded in the field without pre- or post-heating. This characteristic permits on-the-spot fabrication at minimum cost.

Write for free "T-1" booklet which contains design and application information, as well as helpful hints on fabrication of this versatile constructional alloy steel. United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

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United States Steel Supply – Steel Service Centers
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USS

BIDDLE
IMPULSE CABLE FAULT LOCATING EQUIPMENT

...for locating cable faults by impulse tracer method

...for D-C proof testing

This instrument consists of a high voltage d-c impulse transmitter with pickup coil and pointer-indicating detector. Designed primarily for locating faults on lead-covered cable installed in ducts, this equipment has applications also on aerial and buried cable, and has proved highly effective in utility and industrial service.

The transmitters require only 600 va input power at 115 v, 60 cps supply voltage and therefore can be connected to a lighting system.

MODEL 3-2 FAULT LOCATOR

Transmitter and output voltage up to 25 kv—Discharge capacitance 1.65 muf. Provided with three-range milliammeter for measuring insulation current when proof testing cable or other insulation. For use on cable up to 15 kv rating.

MODEL 4-2 FAULT LOCATOR

Transmitter output voltage up to 15 kv—Discharge capacitance 2 muf. For use on cable up to 5 kv rating.

MODEL 5-2 FAULT LOCATOR

Transmitter output voltage 5 kv—Discharge capacitance 16 muf. For use on cable up to 1 kv rating. All fault locators can be used on cable with higher voltage rating if fault conditions are favorable.

WRITE FOR BULLETIN 65-P

B-811

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• SPEED MEASURING INSTRUMENTS
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PHILADELPHIA 7, PA.

PUMPS and COMPRESSORS

Begins on page 290

PUMP and COMPRESSOR BULLETINS: To get your free copies, circle key numbers on Reader Service Card, p 222

687 **Gas pumps,** rotary positive type, are described in 6-p bulletin XA-458. Roots-Connersville Blower, Div of Dresser Industries, Inc

688 **H-p screw pumps** for oil services at discharge pressures to 1000 psig are featured in 8-p bulletin 252. Warren Pumps, Inc

689 **Sump, process pumps,** heavy-duty vertical-centrifugal types, are covered in 12-p bulletin 726.2. Goulds Pumps, Inc

690 **Internal-gear,** sliding-vane and spur-external-gear pumps, 1- to 200-gpm capacities are topic of 12-p bulletin 100. Tuthill Pump Co

691 **Motor-driven** controlled-volume pumps are detailed in 32-p bulletin 553-1. Illustrates, describes standard and modified units. Milton Roy Company

692 **Reciprocating pumps,** vertical and horizontal models, are subject of 8-p bulletin 9900A. The Deming Co

693 **Two-stage** centrifugal pumps are described in 16-p bulletin 7062-C. Ingersoll-Rand Company

694 **Standard screw pumps** are subject of illustrated 6-p bulletin S-206. Warren Pumps, Inc

695 **Submersible pumps** serve as topic of 8-p bulletin LL-6433. Includes units rated from 2600 to 6000 gph. Kenco Pump Division of The American Crucible Products Co

696 **Canned pumps,** fractional horsepower, are subject of 8-p bulletin. The Corley Company, Inc

697 **Sand, slurry pump** is topic of 4-p bulletin 601. Krogh Pump & Equipment Company, Inc

698 **Vacuum** diffusion pumps are detailed in 12-p bulletin. NRC Equipment Corporation

699 **Sealed-gear pumps** are described in 2-p bulletin TR-57D. Bijur Lubricating Corporation

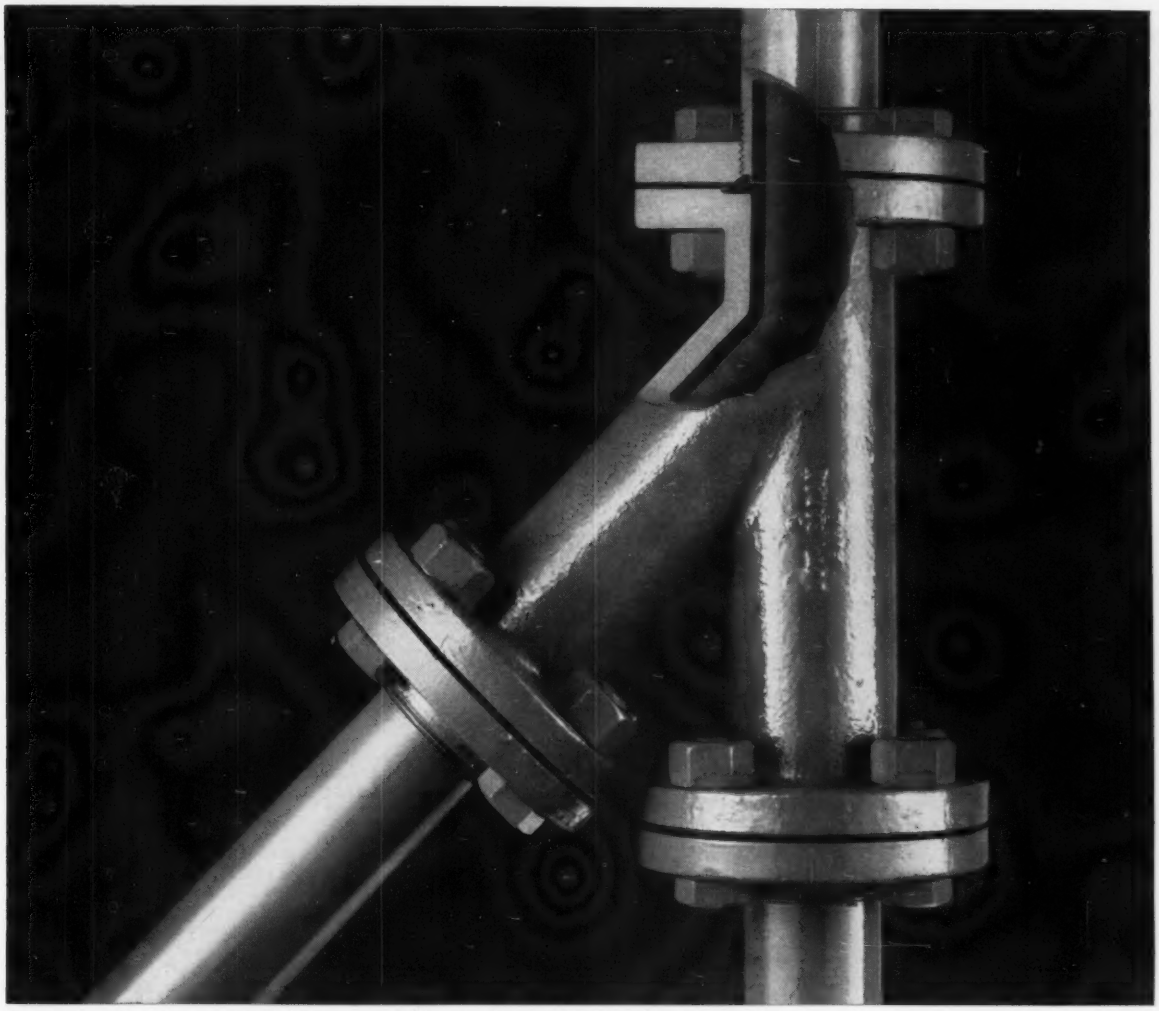
700 **Blower-compressor** units is subject of 4-p bulletin CB-157. U.S. Hoffman Machinery Corporation

701 **Stationary compressor,** heavy-duty high-pressure type, is detailed in 8-p bulletin A-93. Joy Manufacturing Company

702 **Compressors** and steam-jet exhausters are treated in 8-p bulletin 4E. Schutte & Koerting Co

703 **Compressors** in 1000 to 12,000-cfm capacities at 15 psig are detailed in 4-p bulletin LAH-158. Roots-Connersville Blower, Div of Dresser Industries, Inc

For more facts circle 930 on Reader Service Card p 222



Cutaway view shows how corrosive liquids are prevented from touching metal in Saran lined pipe and fitting.

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Power engineers are using more and more Saran lined pipe and Saraloy® 898 tank lining in water de-mineralizing systems. Tough, corrosion-resistant saran is an inert material that won't react with chemically pure water. With a complete system lined with saran and Saraloy, there is no danger of water contamination.

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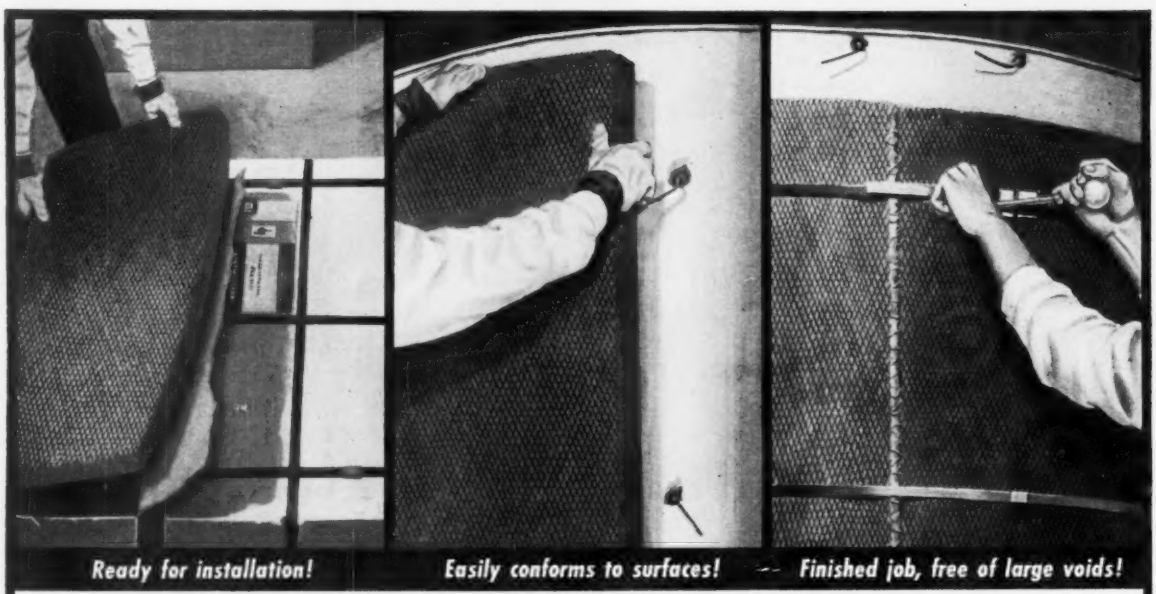

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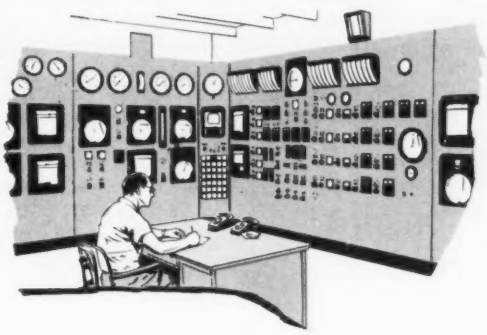
For more facts circle 932 on Reader Service Card p 222



Control and instrumentation development for power services takes a giant step forward each year. Present design trends for controls center around four major goals: component miniaturization, higher precision, faster response and more sophisticated control functions. Component size reduction operates at cross purposes with other goals, but scope and complex nature of present control systems dictates compact panels that can be operated by one person. Trend to more precise control system operations will increase as higher capacity boilers and turbines go into service. An error of ten degrees in steam temperature to the turbine of tomorrow will cost $50,000 a year in fuel alone.

System response is speeding up to handle the time lag created by longer control lines.

L. E. Stuart

Assistant Editor

Recent equipment developments: Circle key numbers on Reader Service Card, page 222, for more details

314 **High-speed sequential operations recorder** is designed for use at electrical power generating stations and unattended substations. Designated the MOR system, it automatically records digital-tape-log sheets. Time difference of 10 milliseconds between events are easily distinguished on printed digital tape. System operates from regular station trouble contacts. Standard 3-in. recording tape is printed with date, time of event, number of trouble contacts, direction of change. Handles inputs to 400 points.—Fischer & Porter Co

315 **Multiple-printing strip-chart unit** prints up to 16 separate records from different telemetering transmission centers. Using a multiple-switch setup, instrument monitors a large number of values from any distance. Variables needn't be all one kind. Unit prints on 12¼-in. chart, comes with 5- or 15-second time-impulse telemetering system.—The Bristol Company

316 **Accurate to ± .001 to .003 sp gr,** system measures, controls fluid density, specific gravity, percent of solids or related quantity. It's applicable to liquids, slurries or divided solids. Based on gamma-ray transmission from a radioisotope, system makes no physical contact with flow.—Industrial Nucleonics Corporation

317 **Electronic recorder receives, notes** up to four remote ring-balance meter-operated slide wires. It can record fluid density, liquid level in open or closed vessels, boiler-drum water levels and temperature- and pressure-compensated fluid flow. Instrument comes as an ac bridge, dc potentiometer or voltmeter. — Hagan Chemicals & Controls Inc

318 **Space-saving panel instruments** use core-magnet movement, are accurate to ± 2% of full scale deflection in dc ranges. The 5-oz units come in dustproof lucite cases, complete with bezel and escutcheon plate.—Simpson Electric Company

319 **Versatile temperature-control system** consists of compact transistorized amplifier (the temperature controller) and vibrationproof mounting containing a thermistor (the sensing element). Thermistor mounting and amplifier relay can be as far as two miles apart. System controls air, surface or immersion temperatures. Amplifier relays come in ranges covering -60 to 520 deg.—Minneapolis-Honeywell Regulator Company

320 **High-accuracy portable instrument** is a combined precision signal source, full potentiometer and milliammeter. Major use: calibrating all forms of amplifiers or servomechanisms that convert small signal voltages (millivolts) into proportional electrical currents (milliamperes) for control or transmission jobs. Overall dimensions are 5-3/8x8x5-9/16 in.; weight is 5½ lb. —Taylor Instrument Companies

321 **Load regulator measures, controls current** to ac motors and circuits. Available with a selection of specially sized cams for automatic set-point adjustment, the electro-pneumatic controller can be adapted for current measurement and transmission or automatic control with reset action. Applications: motor-driven compressors, exhausters, blowers, pulverizers, other equipment having motor drives in 5- to 10,000-hp range.—Hagan Chemicals & Controls, Inc

322 **Unique taut band suspension system** for switchboard instruments uses no pivots or bearings, is completely free of rolling or sliding friction. Only fractional loss is infinitesimal amount of molecular friction within the taut metal bands.—Westinghouse Electric Corporation

323 **Electronic recorder uses a cam** in all its receiver units to correct for nonlinearity of input signals. Result: Recorder can be used with as many as four nonlinear inputs—flow, gas analysis, pH, pressure, liquid level, temperature, etc can be handled on a single equally divided chart.—The Hays Corporation

324 **Air- and water-cooled furnace window** for industrial closed-circuit television camera makes it possible to see inside a furnace continuously. Water is circulated between two glass disks and removes heat radiated by furnace through lens openings.—Dage Television Division, Thompson Products, Inc

325 **Single-unit closed-circuit TV camera** has associated remote-control accessories. Vidicon unit weighs 12 lb, is completely self-contained within camera housing. It

comes with camera tube and 3-lens manually operated turret for quick variation of lens focal length. Intercom provision is built in. Housing measures 5 x 7½ x 12 in.—General Precision Laboratory, Inc

326 **Microhm meter measures resistance accurately,** reads directly in microhms in 0 to 75 range; a selector switch cuts in multipliers for four additional ranges. Meter checks oil- and air-circuit-breaker contacts, transformer windings, rotating equipment.—J W Dice Co

327 **Instrument gives simultaneous measurement** of both alpha and beta gamma activity of air-borne particles as they are collected. Exact amount of radioactivity of sampled area can be read immediately. Basic detector is a gas-flow proportional counter with a thin Mylar window.—Nuclear Measurements Corporation

328 **Heavy-duty indoor-outdoor hygrothermograph** provides equally accurate humidity and temperature indications, both direct-reading and recording. Accuracy is repeatable within ± 3% relative humidity. Operating range is 15 to 95% rh at 32 to 130 F.—Serdex, Inc

329 **Features of h-v dc testing equipment** are reported to include: safety provision, reliable operation, good output-voltage regulation, compact design. Unit measures dc at voltages to 100 kv when applied to insulation of electrical equipment.—James G Biddle Co

330 **Adjustable positioning relay** accurately controls pneumatic motors and valves, can be installed with a screwdriver and wrench. Unit counteracts effects of friction and load factors. It can be attached directly to 3-, 4-, 6-in. pneumatic motors and 8-, 12-in. diaphragm valves. —The Powers Regulator Company

331 **Portable potentiometer-pyrometer** has four interchangeable scales, is used to check and calibrate temperature instruments actuated by any one of ten types of thermocouples. Instrument also measures dc potentials from 0 to 155 mv.—Technique Associates, Inc

332 **Compact indicating transmitter** is designed for pneumatic transmission of temperature measurement from 100 to 600 F, with spans of 100 and 200 F. Upper portion of conventional vapor-pressure thermal curve is expanded over a 4½-in. scale.—The Foxboro Co

333 **Direct-reading ohmmeter** measures down to 10 microhms, has four ranges: x1, x10, x100 and x1000. Instrument with leads and prods weighs 10 lb; case is 13x6x7 in. Applications in electrical maintenance include resistance measurements of electrical conductors, joints, contacts and windings in oil-circuit-breaker assemblies, rotating equipment, transformers and coils. Unit comes with battery or rectifier and automatic circuit breaker.—James G Biddle Co

334 **Clamp-on ammeter measures both ac and dc,** comes in eight sizes for use up to 1000 amp. Improved ammeter has larger damping chamber in each size range to make reading easier. To use, press trigger and snap tongs around conductor.—Columbia Electric Mfg Co

335 **Improved watthour meter** registers voltage variations to 125% without special calibration. Manufacturer reports better electrical and mechanical characteristics for the socket type 2-stator meters and an extended load range resulting from use of slow full-load speed of 8-1/3 rpm.—Sangamo Electric Company

336 **Gas-analysis system continuously samples,** cools, washes and analyzes exit gases up to 3200 F. It can examine gases from all types of combustion equipment for oxygen and combustibles. Completely enclosed in a 66x41x30-in. cabinet, unit contains a gas pump, washer, separator trap, electrical switchgear and analyzer. Weight is 1240 lb.—Bailey Meter Company

337 **Load control protects machinery** and equipment through automatic shutoff, warning or continuous on-off operation. Unit comes with two separate contact ammeters activated by a current transformer connected in one of the motor leads.—Tipptronic, Inc

Free instrumentation bulletins: Circle key numbers on Reader Service Card, page 222, to get your copies

718 **Data-gathering equipment** for field measurements of process variables is listed in 8-p bulletin E72-1. Bailey Meter Company

719 **Instrumentation,** control of nuclear plants is explained in 8-p bulletin B-7233. Westinghouse Electric Corporation

720 **Analog computer,** a portable computer center, is described in 8-p brochure. Century Instrumatic Corporation

721 **Computers** supply text for 6-p folder. Includes programming data. Bendix Computer Division

722 **Supervisory control** is subject of 16-p bulletin GEA-6603. General Electric Company

723 **Annunciator** using static-magnetic controls with no moving parts is fully described in illustrated 4-p folder 101. Panellit, Inc

724 **Accessories, supplies** for industrial instruments are listed in 60-p catalog 500. Includes data on pressure-gage and flowmeter accessories. The Foxboro Co

725 **Frequency-measuring** devices for 400-cps power sources are listed in 8-p bulletin. Varo Mfg Co, Inc

726 **Speed measuring** instruments, all ranges and types, are covered in 20-p bulletin 35. Fully illustrated. James G Biddle Co

727 **Automatic controls** are covered in 60-p catalog 858. Includes data on pressure, temperature, liquid-level, mechanical-movement controls; relays and switches. The Mercoid Corporation

728 **Receiver-recorder** and controller for pneumatic and electric transmission and mechanical measuring systems is described in 16-p bulletin. Bailey Meter Company

729 **Liquid and air,** steam or gas meters are topic of 6-p bulletin 100-R1. Builders-Providence, Inc

730 **Pressure regulators** for control of air or steam to 250 psi at 450 F are discussed in 6-p bulletin. Crane Company

731 **Automatic** control-system application to large central-station boilers is discussed in 12-p bulletin 1032. Copes-Vulcan Div, Blaw-Knox Company

732 **Actuators,** pneumatic-power type, are topic of 12-p bulletin B-50-3. Conoflow Corporation

733 **Flowmeters,** differential-pressure type, are discussed in 22-p bulletin F1607. The Bristol Co

734 **Pyrometer supplies** are listed in 54-p catalog G100-8. Includes photos, complete specs. Minneapolis-Honeywell Regulator Co

338 **Smoke density is accurately measured,** indicated, recorded by photoelectric instrument. Pressure-sealing flanges seal sighting tubes on which light source and scanner are mounted.—Electronics Corp of America

339 **Pneumatic transmitter measures pressures** to 250 psi and liquid level ranges from 0 to 100 in. Operating on force-balanced principle, model transmits linear 3- to 15-psi signal to recorder, indicating gage or manometer. Unit can be mounted horizontally or vertically on open or closed tanks.—Conoflow Corporation

340 **Area type flowmeter** is reported to measure flow rates accurately with new standards of float stability. It also features a quick-out flow tube for easy maintenance and range change. Capacity depends on specific gravity of fluid, size of flow tube, float weight. Standard meters range from 0.0001 to 30 gpm water (0.0002 to 90 scfm air). For other capacities and fluids, interchangeable floats of various materials are supplied.—C-Mar Corp

341 **New line of gages** for indicating and controlling gas or air pressure combine an indicating draft gage with magnetic mercury switch for operating an alarm or signal light. Units come with one or two switches for either high or low electrical contacts, or both, for alarm purposes.—Ellison Draft Gage Co

342 **Versatile flow switches** make or break an electrical circuit when flow starts or stops. Compact moderately priced unit is mounted in the tee of a horizontal line, extends a paddle down into pipe. Liquid flow in the pipe moves paddle and closes switch to complete the electrical circuit. Circuit remains closed until flow stops, allowing paddle to resume its normal position. Maximum working pressure is 100 lb; maximum temperature, 300 F.—McDonnell & Miller, Inc

343 **Pilot-operated control** maintains any level within 1 to 2 in. plus or minus of setting. Unit consists of exterior float, pneumatic pilot and diaphragm motor valve. Float movement causes pilot to apply or release pressure on valve.—Stickles Steam Specialties Company

344 **Pneumatic controller has band adjustment** from 2 to 500%, less than 0.05% dead band, and either remote pneumatic or local spring set-point adjustment. Design is based on null-balance-vector principle. Proportional band is changed by loosening lock screw and moving it along a scale.—Republic Flow Meters Co

345 **Mercuryless fluid-flowmeter** uses reformed highly sensitive diaphragms stacked together for positive overrange protection to full static pressure. Differential ranges are 0-20, 0-50, 0-100, 0-200 in. water. Rectangular or circular case, yoke or flush-mounted units are available for 2000-psi service.—The Foxboro Company

346 **Differential-pressure transmitter** for liquid-level use, has an accuracy established at 1% of range span. Damping is built in at measurement source and distortion due to outside forces acting on cover is reported eliminated. Static pressure effect is less than 0.2% per 100-psi change.—Mason-Neilan, a Division of Worthington Corporation

347 **High flexibility is feature** of chromatography analyzer with range from ambient to 425 F. Gas chromatograph is basic instrument with optional accessories for specialized applications.—Loe Engineering Company

348 **Furnace tubewall thermocouples** reportedly slash installation time 75% because they're made of ceramic-insulated conductors cased in metal sheathing. Units can be bent, and will flex with differential motion between tubes and wall.—Thermo Electric Company, Inc

349 **On-the-spot reproduction** of microfilmed engineering drawings is provided by new processor. It uses aperture cards containing 35-mm film, can also use roll film or acetate jackets in 16- or 35-mm sizes.—Remington Rand Div. Sperry Rand Corporation

350 **Compact 6-alarm-point annunciators** are for remote locations where trouble source must be identified and recorded. Unit has static switching circuit containing silicon diodes, thermistors.—Scam Instrument Corp

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735 **Indicating controllers** for pressure-temperature control are described in 16-p catalog 510. United States Gauge Div, American Machine & Metals, Inc

736 **Potentiometers,** 10 precision models, are described in 28-p catalog GR107. George Rattray & Co

737 **Liquid level,** flow controls and their uses at the Experimental Boiling Water Reactor make up 10-p bulletin. Magnetrol, Inc

738 **Liquid-level gages** are discussed in 48-p catalog 36. Penberthy Manufacturing Company

739 **Gages, thermometers,** instruments and controllers are listed in 6-p bulletin 3010. United States Gauge Div, American Machine & Metals, Inc

740 **Electric thermostat** for temperature control and movement of heavy liquids is described in 4-p bulletin RT-808. Robertshaw-Fulton Controls Company

741 **Pressure regulators** and how to select them is theme of 28-p bulletin 401. Kieley & Mueller, Inc

742 **Gages,** from 15 to 20,000 psi, are detailed in 48-p catalog G58. Kunkle Valve Company

743 **Thermostat** for equipment using two heating elements is covered in bulletin RT-807. Robertshaw-Fulton Controls Company

744 **Industrial TV** is subject of 12-p bulletin 2239. Contains selection data, case histories. Diamond Power Specialty Corporation

745 **Water gages** for boiler pressures to 3000 psi are described in 6-p bulletin WG-1814. Units give 2-color readings of water, steam. Yarnall-Waring Company

746 **Rotameters** for 5000 psi, flow-rate equivalents to 3000 gpm water are subject of 8-p bulletin 130. Brooks Rotameter Company

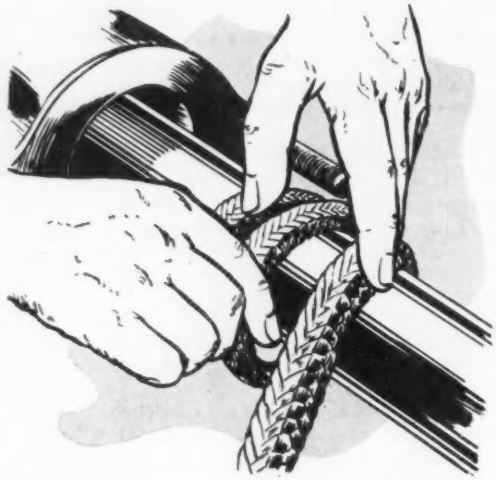
747 **Liquid level control** which operates with no moving parts in flow is topic of 16-p catalog. B-W Controller Corporation

748 **Flowmeters,** variable-area types, are discussed in 15-p bulletin 10A-9010. Gives engineering data. Fischer & Porter Company

749 **Electronic recorder** for noting pressure, temperature, flow, liquid level is topic of 8-p bulletin-spec sheet package. The Hays Corp

750 **Pressure - vacuum** controls are subject of 8-p catalog 500. United Electric Controls Company

751 **Engine hour meter** catalog 600 has 12 pp of data on ac, dc meters. Stewart-Warner Corporation



An ounce of prevention . . . is the maintenance man's creed. And the best way to practice this belief is to keep up with and apply new products that prevent headaches. Following are some of the hottest ideas in seals that have come across our desk. Since coping with higher pressures and the more corrosive fluids of today isn't an easy job, look them over carefully. Superfinishing is gaining ground as a means of keeping valve seats tight and cutting down on wear. Raised floors — old hat aboard ship—are finding wider use in power plants. They give space to add piping. These are just a few new products designed to help you lick your knotty maintenance problems.

Stan Elonka
Associate Editor

New equipment and products: For more data on these items, circle key numbers on Reader Service Card, p 222

351 **Mechanical packings are color coded** for positive service identification, mix-up prevention and simplified inventories. Adaptable to process industries, three styles cover full pH scale.—A W Chesterton Company

352 **Positive sealing of active solvents** and corrosives is made possible by Teflon clipper seals. Teflon body is encased in stainless steel or other corrosion-resistant alloy. Seal lip is actuated by stainless alloy spring.—Johns-Manville Corporation

353 **Composite bearing material needs no lube,** has static coefficient of friction against polished steel of 0.04. Recommended uses are for: dry bearing services, both sliding and rotating at temperatures to 500 F; solvent applications; jobs subject to impact, since it won't permanently deform from shock.—Crane Packing Co

354 **Gasket cutting is simplified** by new dovetail designer which is placed on gasket flange, used as pattern in outlining exact design. Centering line on dovetail reportedly assures accurate use on any width gasket flange. Unit is lightweight phenolic with nonslip gripping points. Companion gadget is bolt-hole locator. When placed over a pivot pin in center of gasket, equally spaced notched measurements are reported to accurately determine center point of bolt holes, regardless of the number of holes or the size of the gasket.—Zimmerman Packing Company

355 **Maintenance lapping machine** consistently refaces mechanical seals, valve seats, compressor disks or fuel-injector parts to a precision flatness of .0000116 in. It does not have to be stopped for redressing or truing lap plate. The machine operates from standard 110-v 60-cycle single-phase outlet.—Crane Packing Co

356 **Endless, jointless hydraulic seal,** molded of synthetic compounds, is reported to be impervious to water, oil and oil solvents. Flared-lip construction results in perfect seal even at low pressure; thick top allows Mon-Oseal to withstand great hydraulic shock without distortion, maker reports. It can be installed in any depth stuffing box from $1\frac{1}{2}$ in. up, and operates at any hydraulic pressure.—A W Chesterton Company

357 **Low-cost method of nickel-alloy cladding** is reported to resist corrosion, increase service life of ferrous tubing and pipe. After application, coating is heat-fused in a reducing atmosphere, forms bonded interface with base material which resists scaling, even when base is bent to 180 deg.—Tube Reducing Corporation

358 **High-impact cooling-tower packing** resists biological growth and deterioration in water. Made of polystyrene or linear polythyleme, packing comes in 3x3- or 2x4-ft grids made up of vertical ribs about 2 in. apart. Product is light weight.—The Fluor Corporation, Ltd

359 **Industrial air dryer** removes water vapor from compressed air to stop condensation in piping systems. Designed for continuous operation, unit is shop-assembled on an integral structural-steel base, with piping and controls self-contained. Dryer is self-powered by compressed air; a reciprocating pump is only moving part.—T Melsheimer Company

360 **Built-in primer is feature** of liquid-neoprene protective coating. Reported advantages are: ease and flexibility of application; long-lasting resistance to weathering, chemical fumes, salt spray and corrosion creep.—Charleston Rubber Company

361 **Nondestructive testing of steel welds,** opaque materials is handled by portable unit. At full load—100 kvp at 4 ma—it operates for 50 min. Tester weighs 45 lb, comes in $16x12x6\frac{3}{4}$-in. enameled-steel case. Provides sharp detail.—Philips Electronics Inc

362 **Precise nondestructive measurement** of thickness of coatings and platings is job of compact instrument. It can be used to test metallic film or foil from .00005 to

.007 in. thick, and can detect cracks in both smooth and rough coatings, flat stock and tubing. The lightweight instrument operates on the swept-frequency eddy-current principle.—Gulton Industries, Inc

363 **Test plugs seal small inspection holes** used by metal inspectors for measuring wall thickness of pressure vessels, process equipment and piping. They come in carbon steel, monel, brass, stainless-316 and inconel, to assure compatibility with metal of tapped hole and to prevent galvanic action between wall and test plug. —Nuclear Products Company

364 **Efficient ultrasonic cleaner** has self-contained filtering system, operates on frequency of 40 to 44 kc. It incorporates a forced-air cooling system and has cleaning-tank capacity of one gallon. Unit cleans by cavitation produced by ultrasonic signals transmitted in liquid; any small part, tool or instrument not damaged by immersion in water or chlorinated solvents may be cleaned.—Gulton Industries Inc

365 **Inhibited muriatic acid** removes most water scales and corrosion products from boilers, recirculated cooling-water systems and water heaters. Cleaner comes packaged in 5-gal polyethylene-lined steel drums with non-drip spouts.—Alken-Murray Corporation

366 **Colloidal-suspension spray** protects outdoor storage piles of bulk material against all weather. Tough, flexible film is formed on exposure, sets in 24 hr. It resists action of wind, frost, heat; drains off rain water to stop channeling. Product coats stock piles of coal, ores, coke breeze, flyash, sand, waste. It can be used in most sprayers.—The Johnson-March Corporation

367 **High-strength flexible lacing** is for troughed conveyor-belt use. Designed for quick, simple installation, the heavy-duty hinge splice is reported to eliminate need for templates, drilling or hole punching. Offered for belts 3/16- to ¾-in. thick.—General Splice Corporation

368 **New type of raised floor** can take loads of 275 lb per sq ft, can be laid directly onto existing floors without need for a permanent supporting structure. The floor is laid by assembling 36½x36½-in. modules which rest on adjustable pedestals. Each module has four cast-aluminum plates placed in a steel frame. Whenever space changes mean rearranging floor, the completely interchangeable modules and plates can be raised with a hand suction-cup lifter. The floor can be picked up by sections and moved to other locations. This flexibility makes it adaptable for use wherever machinery and auxiliary power equipment are involved. Subfloor areas can house cables, pipes.—Floating Floors, Inc

369 **Heavy-duty high-strength grout** is for machinery where vibration and other operating conditions are severe. Physical properties include tensile strength of 1950 psi (nearly five times that of concrete), compression strength of 15,000 psi, bond strength to steel of about 1000 psi. Cures in 24 to 48 hr.—The Ceilcote Co

370 **Noiseless, blastless exhaust** is feature of portable air tool line. Initial models include light- and medium-duty drills, screwdrivers and tappers. Noise is stopped by routing exhaust air back through a system parallel to inlet system, so it escapes at a point adjacent to air inlet. A porous bronze diffuser at the outlet deadens the remaining noise and dissipates the escaping air evenly in all directions.—Aro Equipment Corporation

Free maintenance bulletins: To get your copies, circle key numbers on convenient Reader Service Card, p 222

752 **Rubber fact book** has 16 pp, helps in selection of O-rings, other ring seals. Sizes are cross indexed. Minnesota Rubber Company

753 **Sheet packings** for industry are detailed in 8-p illustrated bulletin P-328. Crane Packing Co

754 **Asbestos packing** and gaskets are described in 8-p bulletin. Durabla Manufacturing Company

755 **Gaskets,** spiral wound metal types, are subject of 12-p bulletin AD-104. The Garlock Packing Co

756 **Plastic gasket** and shim stock with double-identification feature is described in 4-p bulletin 570. Chicago-Wilcox Mfg Co

757 **Neoprene** liquid-rubber coating with built-in primer is topic of 4-p bulletin. Includes application data. Charlestown Rubber Co

758 **Anticorrosion coating** for mild steel is subject of 4-p bulletin. Tube Reducing Corporation

759 **Protective coatings** are described in 36-p manual 257. Features color chips of 102 coating items, primers. Rust-Oleum Corporation

760 **Plastic coatings,** fluidized for corrosion resistance, are topic of bulletin. American Agile Corp

761 **Protective closure** for sealing or masking threaded parts, pipe ends, tubing are discussed in 4-p bulletin. Shurclose Seal Co

762 **Work techniques** to cut cleaning, maintenance costs are explained in 28-p handbook. Advance Floor Machine Company

763 **Concrete floor** maintenance program is outlined in 4-p folder. Multi-Clean Products, Inc

764 **Surfacing** concrete floors is topic of illustrated 4-p bulletin. Kalman Floor Company

765 **Conveyor belt** trouble-shooter is pocket-sized slide card giving quick method for spotting trouble. United States Rubber Co

766 **Tube expanders,** torque-control unit cutters and accessories are detailed in 32-p bulletin 81. Gustav Wiedeke Company

767 **Electric motor care** is topic of 16-p bulletin. Discusses friction, moisture. Chicago Electric Co

768 **Jacketing materials** and methods are discussed in 40-p catalog. Contains application diagrams, full specs, handling tips. Kaiser Aluminum & Chemical Sales, Inc

769 **Linings** of polyvinyl chloride are described in illustrated 12-p bulletin. F Kaykor Industries, Inc

770 **Nondestructive testing** service is covered in 10-p brochure. Magnaflux Corporation

771 **Cleaning machines** for all applications are described in 49-p bulletin. The Kent Company

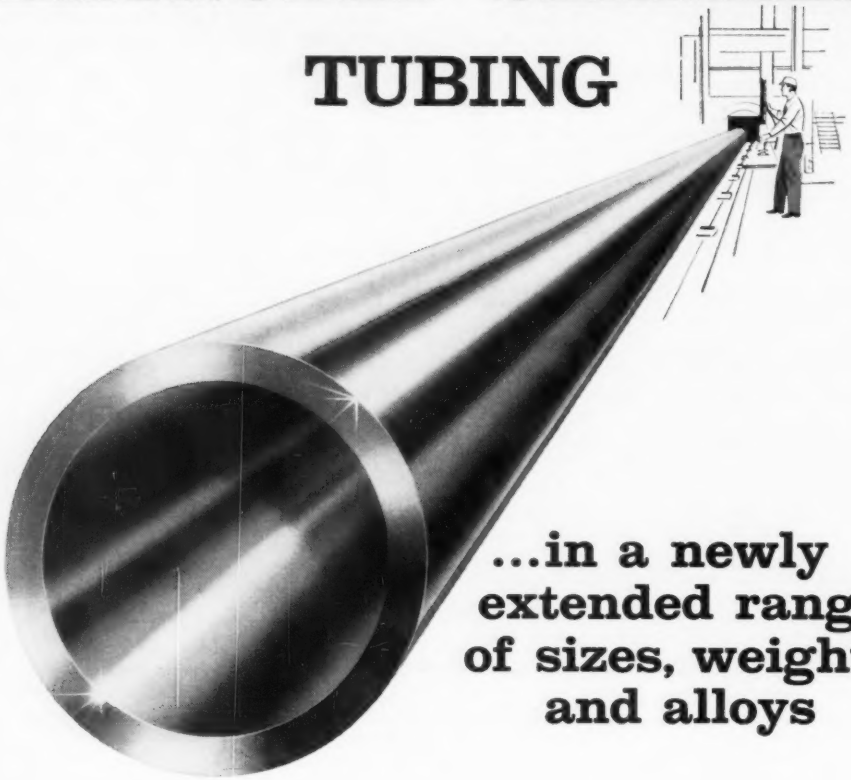
772 **Low-cost fasteners** are subject of 6-p bulletin. Sizes are stamped directly on face. Rotor Clip Co

773 **Insulating materials** are detailed in 20-p catalog. Specs, application instructions are given. Baldwin-Hill Company

774 **How to strip paint** is title of 8-p bulletin F7893. Describes types of strippers, working methods. Oakite Products, Inc

775 **Plastic steel** and other repair products are covered in 8-p bulletin 3. Devcon Corporation

Curtiss-Wright
EXTRUDED SEAMLESS TUBING



...in a newly extended range of sizes, weights and alloys

The recognized advantages of Curmet extruded steel tubing... *high transverse strength, uniform physical properties, longer lengths* . . . are now available for the first time to a wide range of industrial applications.

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Must have had executive responsibility for sizeable research organization, with leadership capacity to GET THINGS DONE, combining *scientific* and *executive* qualities.

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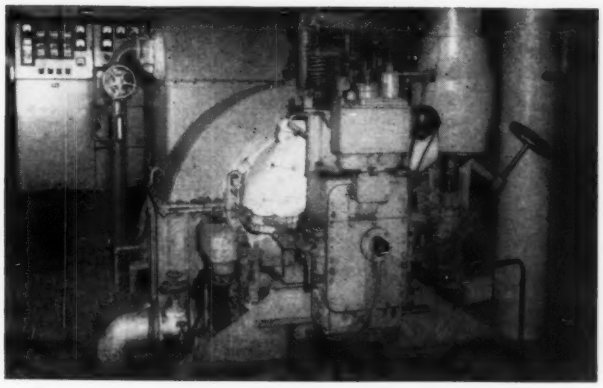

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Surface condenser
3800 Sq. Ft.

Complete Auxiliaries

Switchboard & Dual Drive Exciter

New 1944

400 Lb. Pressure 750° G.E. Turbine Generator

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2500 KW @ 70% P.F.

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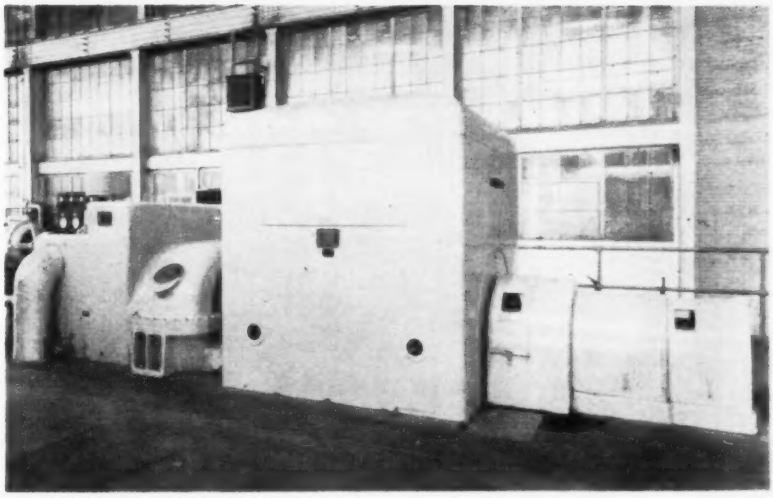

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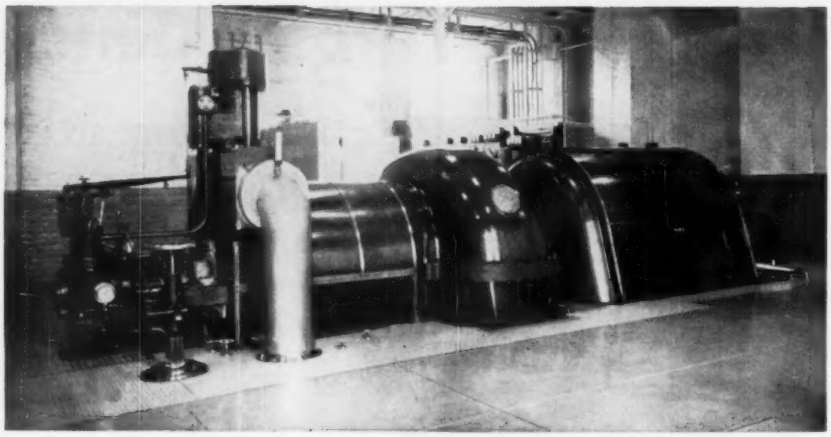
400 PSIG, 700°FTT 3 PHASE 60 CYCLE 2400/4160 VOLTS



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SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
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400	West. S.B. Open	CS	900
350	A.C. S.S. Drip	ARWW-626	3600
300	G.E. S.B. Open	IK	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1002	600
250	G.E. S.B. Open	KT	1800
250	G.E. S.B. Open 2200 V	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	G.E. B.B. Drip	K-6325	1800
200	Cont. T.E.F.C. B.B.	NP-686C	1800
200	C.W. B.B. Drip.	SC-86A	1800
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-15S	1200
200	G.E. S.B. Open 2200 V	IK	1200
200	G.E. S.B. Open	IK	900
150	West. TEFCBB XP	CS-773.6	3600
150	Ideal B.B. Open. New	A-585	1200
150	G.E. S.B. Open	KT-558	900
150	G.E. TEFCBB	K-6328	3600
150	G.E. TEFCB XP	K	3600
150	G.E. TEBB	K	1800
150	West. S.S.B. Open	CS-773C	1800
150	West. S.B. Open 2200 V	CS	1800
150	G.E. S.B. Open	IK	1800
150	West BB Open	CS-771C	1800
150	G.E. B.B. Open	KT	1200
150	Cont. T.E.F.C. B.B.	New	900
150	G.E. S.B. Open	IK	720
150	West SB Open	CS-878A	720
125	West. TEFCBB	CS-580C	900
125	G.E. S.B. Open	FT-543	3600
125	G.E. TEFCBB	K	3600
125	West. S.S.B. Open New	CS-607	1800
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS	1800
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125	G.E. S.B. Open	IK	1200
125	G.E. S.B. Open	IK	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
100	Howell TEFCBB	K-505	3600
100	Wag. TEFCBB	CP-635	1200
100	West. B.B. Splash.	CS-754C	900
100	G.E. S.B. Open	KT-356	900
100	El. Dyn. T.E.F.C.B.B. XP	KNX-223	1800
100	G.E. S.B. Open	KT-343	1800
100	A.C. S.B. Open 2200 V	ARX	1800
100	L.A. TEFCBB	JX-113	1800
100	West. S.S.B. Splash	CS-770.3	1200
100	G.E. B.B. Open	K-504	1800
100	G.E. S.B. Open	KT-347	1200
100	West S.B. Open 2200V	CS-774C	900
100	G.E. S.B. Open	IK	900
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75	West. B.B. Splash. 440V	CS-445	3600
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75	West. TEFCBB	CS-505	1200
75	Cont. TEFCBB	AF-109X	900
60	L.A. TEFCBB XP	EX-445	3600

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1—300 KVA, 3/60/4160-240 Wagner, ITE type HPE Unit Substation, Outdoor.
2—250 KVA, 1/60/2400-240/480 Moloney OISC, type YC, with taps
1—250 KVA, 4—150 KVA, and 2—100 KVA 1/60/4160-240/120 Whse. Incrtcen with taps
1—200 KVA 3/60/4160-240 Wagner, ITE type RPB Unit Substation, Outdoor.
3—15 KVA, 1/60/240-480/120-240 Sorgel Dry

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For Surplus Electrical Equipment

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Phone GArfield 1-4290

SAVE MORE DOLLARS

3 only—1500 KVA G. E. Transformers, 110,000 to 2400 Volt, Type H, Form DJ, OISC, Excellent.

1 only—750 KW G.M.C. Diesel Generator, 938 KVA Westinghouse Synchronous Generator, 2300 Volt, complete with panel.

1 only—Type KCA-44 General Electric Carrier Current Telephone Equipment, Two—Frequency Duplex.

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4—Keeler 200 HP, 160 PSI, water-tube, complete with accessories.

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1—Raymond 66" dia. 6 roll mill, 200 HP
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ELECTRICAL POWER EQUIPMENT

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	SP806S	4800/2400	1800
1	800	Whse.	CW	550	1776
1	700	Al. Ch.	D.P.	2300	500
1	600	Whse.	CW-432D-15	440	1778
1	500	G.E.	MT-412	2200	439
1	500	Whse.	CW	550	350
1	350	Cr. Wh.	SIZE-718R	203/406	1763
1	350	G.E.	IM-17A	440/2200	720
1	350	Whse.	CW-1028C	440	720
1	250	G.E.	MT-424Y	4000	257
1	250	Cr. Wh.	SIZE-290	2300	350
1	250	A.C.		550	600
1	250	G.E.	MT-563Y	440	875
1	250	Whse.	CW-1010	2200	435
1	200	Whse.	CW-874D	220	885
1	200	G.E.	IE-13B	220	1760
1	200	G.E.	IM	2200	580
2	200	G.E.	IM	2200	435
2	200	Whse.	CW-890	2300	1775

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
1	500	G.E.	FT-559AY	2300	3600
1	550	Whse.	CS-1115	2300	900
4	500	Whse.	CS-1216	2200	500
3	500	G.E.	KF	2300	3600
2	450	Whse.	CS-1420	2300/4150	354
2	400	Whse.	CS-7151-610H	6600/4000	3565
1	400	G.E.	LK	2200	590
1	300	Whse.	CS-1002	2300	600
1	200	Whse.	CS-963H	2300	1175/878
1	200	G.E.	KT-557	440	1800
2	200	Whse.	CS-8558	220/440	1750
1	150	G.E.	CS	440	530

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-SL	13800/6900	514
1	3500	G.E.	TS-6438P	2300/4000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	660	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1000	G.E.	900	250	6600
2	1000	G.E.	720	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	500	Whse.	900	125/250	440
1	350	G.E.	900	125	440/2300/4160
2	300	G.E.	1200	250	2300
1	250	Whse.	1200	275	2300
1	200	El Mby	1200	250	2300/4600
1	300	Whse.	1200	600	2300
1	200	Whse.		550	2300
1	200	G.E.	1200	250	550/3300
1	200	Cr. Wh.	1200	250	440
1	150	Whse.	1200	275	2300
1	100	G.E.	1200	250	4160/2400

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	7500	Whse.	650# condensing, 125# auto extraction, 6900°.
1	5000	G.E.	400# surface condenser 2400/4150 volts.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	3333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x35/55
3	500	KUHL	OISC	1	13600x6000
1	225	Marcus	Air	3 auto	208/220
3	100	G.E.	OISC	1	2900x2400/4160Y
3	100	Whse.	OISC	1	4600x460/230/115

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
3	6750	G.E.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300
1	500	Al. Ch.	25/60	11000/2300
1	200	G.E.	60/3000	440/880

COMBINATION MILL DRIVES—
D.C. MOTORS WITH M.G. SETS & CONTROLS
PACKAGE DRIVES IN STOCK

1—2250 HP Elliott 300 V. 200/300 RPM DC Motor with 2400 KW GE MG Set. 300 V. DC 2300/4600 V. 450 RPM 3 ph. 60 cy.
1—1375 H.P. G.E., MCF, 415 V. 1300 RPM D.C. motor with 1100 KW G.E. MG Set 415 V DC, 2300/4000 V. 720 RPM 3 ph. 60 cycle.
1—1200 HP G.E. MPC, 600 V. D.C. Motor, 450 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 KP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

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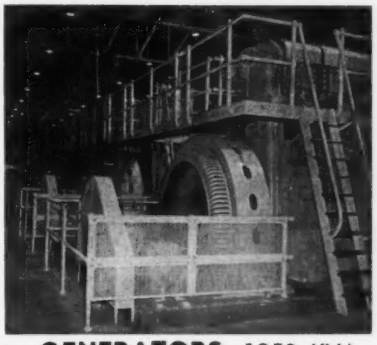
Tel: OLDFIELD 3-3334

POWER PLANTS



13,750 KVA POWER PLANT STILL INSTALLED

Will be sold as complete unit or piece by piece. Consists of (11) 1250 KVA Rathbun-Jones Natural Gas Generator Sets. **ENGINES**—1430 HP, 8 Cylinder, 4 Cycle, 300 RPM, direct connected to **GENERATORS**—1250 KVA, .8PF, 3/60/2400-4160. Complete with Switchgear. Can be seen inoperation on foundations.

2500 KVA POWER PLANT

Will be sold individually or as a complete unit. **TURBINE**—9 Stage, Non-Condensing, Automatic Extraction, 600 PSIG, 600° FTT, 150# Extraction, 30# Back Pressure, 3600 RPM, direct connected to **GENERATOR**—2000 KW 3/60/480 Volts complete with Controls. **BOILER**—4 Drum Bent Tube, 75000#/hr. 650 PSIG, 650° FTT with Water Walls, Oil Fired complete with Fans and Feed Water Pump.

1875 KVA POWER PLANT

STILL INSTALLED. Will be sold as complete unit or piece by piece. **TURBINE**—400 PSIG, 700° FTT with Surface Condenser and Pumps, direct connected to **GENERATOR**—1875 KVA, .8PF, 3/60/2300/3600 RPM, complete with Controls. **BOILER**—25,000 #/hr 450 PSIG, 738° FTT, Stoker Fired with Superheater, Fans, Feed Pumps. **AUXILIARIES**—Deaerating Heater, Coal Crusher, Elevator and Conveyors. **CRANE**—25 Ton, 36' Span.

12 NEW UNASSEMBLED BOILERS

B&W, Combustion Engineering, Foster Wheeler. Steel encased. 2 Drum Water Tube with Water Walls, Superheater, Economizer, Soot Blowers, Oil Burners. Complete.

# Steam/hr	PSIG	FTT
122,500	565	850
44,500	450	735
35,000	285	577

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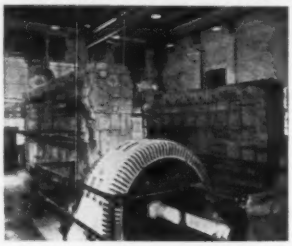
HEAT & POWER Co., INC.
POWER EQUIPMENT DIV.
60 East 42nd St., N. Y. 17, N. Y.
Telephone: MUrray Hill 7-5280

• AVAILABLE FOR IMMEDIATE DELIVERY •

1400 KW FAIRBANKS MORSE—MODEL 33F16—Located Honolulu, T. H.

- New 1948
- Less than 15,000 hours total operation
- Will convert to dual fuel

1000 KW SUPERIOR—MODEL 80SX—Located Tavernier, Fla.



- New 1951
- Less than 15,000 hours operation since rebuild
- Will convert to dual fuel

Units Can Be Seen in Operation in Present Locations

• WRITE FOR DETAILED SPECIFICATIONS •

DIESEL ENGINES — POWER MACHINERY

100 KW to 1500 KW

Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

A. G. SCHOONMAKER COMPANY, INC.

MAIN OFFICE: Box 516, Sausalito, Calif. EDgewater 2-1490 — BRANCH: 50 Church St., N. Y. 7, N. Y. Digby 9-4350

HIGH PRESSURE STEAM BOILERS

***Government Surplus* SAVE OVER 75%**

NEW, NEVER USED, NEVER ERECTED, AVAILABLE IMMEDIATELY

121,650 Lbs.

1 Foster Wheeler

Express Type, 3-drum, with integral superheater separately fired.

Includes boiler, superheater, economizer, 7 fuel oil burners, soot blowers.

Pressure 634 psi, temp 850° F.

Furnace Vol: boiler 310 cu. ft., superh. 247 cu. ft.

60,000 Lbs.

10 Babcock Wilcox
3 Foster Wheeler

"D" Type, 2-drum, with integral superheater fired between boiler tube bank.

Includes boiler, superheater, economizer, 3 fuel oil burners, soot blowers.

Pressure 435 psi, temp 750°F.

Furnace Vol: 330 Cu. Ft.

We own and stock these boilers. Inspection Invited at Utica, N.Y. Subject to prior sales.

Also on West Coast:
2—122,500# B & W's; 1—74,000# Header Type B & W; 1—60,000# Foster Wheeler

PELNIK-LOCONTI INDUSTRIAL SUPPLY CO.

Office Ph. Utica 6-4621 • 315 Oriskany St., Yorkville, N.Y. • Yard Ph. Utica 2-4513

DIESEL GENERATOR SETS

1250 KW Cooper-Bessemer Dual Fuel, 1650 HP, 327 RPM, supercharged. Westinghouse 3/60/2300 generator with all accessories. New 1949.

400 KW General Motors Quad portable diesel generator. 650 HP. Skid mounted radiator cooled. Westinghouse 3/60/2300 generator, complete, used 60 days.

Both units in excellent condition. Priced attractively.

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611 Olive St. St. Louis 1, Mo.
CHestnut 1-4474

FOR SALE

(20) 50,000# PER HOUR

COMBUSTION ENGINEERING

PACKAGE TYPE BOILERS

250# PRESSURE. BUILT IN 1950.

BOILER & EQUIPMENT CO.
743 Bedford Ave., Brooklyn 5, N.Y.

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/8660-4160/2400
2	750	G.E.	K	1	4800-120/240
1	300	West.	Power Ctr.	3	2400/4160Y-120, 240 or 480
1	300	Penna.	(Askarel)	3	12470Y/7200-240
3	250	G.E.	H Pyranol	1	4800/8320Y/120/240
2	250	West.		1	2300/4600-220/440
1	225	Kuhlman	OISC	1	440-100 (Furn.)
3	200	G.E.	H	1	7800-15600-220/440
1	150	Eisler	OA	1	4160-240/480
3	100	G.E.	H		2400/4160-240/480
3	50	G.E.	HS	1	2400/4160-240/120
1	50	Amer.	Abestol	3	4160-120/208Y
5	50	G.E.	HS	1	2400/4160-240/480
4	25	West.	Hypersil	1	2400/4160-120/240
3	15	West.	H Pyranol	1	6900/11950Y-120/240

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
3	60	E.M.	1200	125	220 v. Syn.
1	75	G.E.	1200	125	2300/4160 Syn.
2	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R.
1	300	G.E.	1200	250	440 Syne.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas EXD 62.5 KVA Westghe 3/60/480—1200

1—Wisconsin Gas (Air) PE-99 7.5 KVA Master 1 or 3/120—2200 r.p.m. NEW.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	690	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	IM	440
2	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M569Z	2300/4160Y

D.C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	30	West.	1750	SK 113
1	75	Star	1200	SB 60 L B.B.
1	350	G.E.	1200	Pedestal

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP, 1800 RPM G.E. Type K 63368 4150 V
1—275 HP, 1180 RPM G.E. Type KT 559BS 2200V
2—200 HP, 1790 RPM, G.E. Elec. KF, TEFC, 2300V
1—401P, 1750 RPM Wagner 444 440V T.E.F.C.
1—251P, 1170 Howell 405 440V T.E.F.C.

MOTORS—SYNCHRONOUS—3 ph. 60 cy.

125 HP 600 RPM G.E. Type TS 2200 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HP 1800 RPM G.E. Type TS 220 V.
300 HP 720 RPM Elec. Machinery L.e.f.c. 2300 V.
4100 HP 450 RPM Westinghouse Type HR 440 V.
1000 HP 360 RPM Westinghouse Ped. Type 2300 V.

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1603 54th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK—LONGACRE 5-3727
PHONE NEW JERSEY—UNION 3-2600

POWER EQUIPMENT

300 KW G.E. Non-C. Turbo Generator
3/60/480—150# 5-10#-BP 3600 RPM

1800 KW G.E. Cond. Turbo Generator
3/60/2400—410# 725°FTT

45000# Combustion Engineering BOILER
450# 750°TT oil fired

500 KVA 3 ph 60 cy 4150 V G.E. NEW STEP VOLTAGE REGULATOR

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

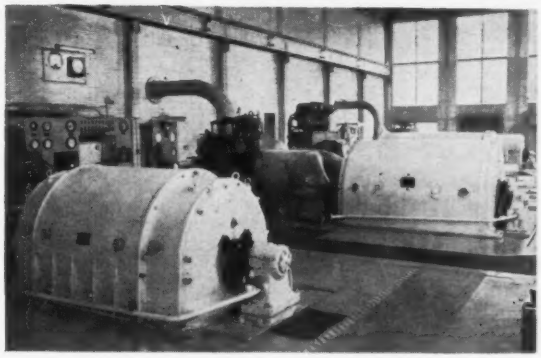
1902 **COMPRESSORS** 1958
WORLD'S BEST REBUILTS

100 CFM 125 psi 6x7 Ing.
116 CFM 50-150 psi 7x9 Pa. Booster
138 CFM 100 psi 7x7 Ing. ES-1
191 CFM 350 psi 9-4x9 Ing. ES-2
238 CFM 100 psi 9x9 Worth. HB
268 CFM 500 psi 10-4¼x10 Ing. or Worth.
465 CFM 100 psi 12x11 Ing.
502 CFM 125 psi 12x13 Worth. H.B.
585 CFM 100 psi 15-9¼x12 Ing. XRE 3-60-4160
590 CFM 100 psi 13½-8x8 Penn DE2 3-60-220
628 CFM 100 psi 14x13 Worth HB
676 CFM 100 psi 15-9¼x12 Ing. XRB—Worth.
870 CFM 125 psi 17-10½x12 Ing. XRE 3-60-220
920 CFM 110 psi 18-11x12 CP-OCE
1302 CFM 125 psi 20-12x14 Chic. OCE 225 H.P.
1721 CFM 100 psi 23-14x16 Ing PRE 2
7950 CFM 200 psi 33-17¾x27 IR-PRE2-4C

AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 47th St. North Bergen, N. J.
UNion 5-4848

SPECIAL OFFERING!

650 lb., 725 DEG TURBO GENERATORS — Still on Original Foundations As Shown in Photo Below — All Westinghouse, 3600 RPM, 80% P.F., 6900 V, 3/60.



1—9375 KVA, 7500 KW, 125 P.S.I.G. auto extraction, surface condenser, installed in 1937.
1—9375 KVA, 7500 KW, non-condensing, 125# B.P., installed 1930.
1—6250 KVA, 5000 KW, Condensing, with surface condenser, installed 1942.

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BELYEA CO. INC.

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APPARATUS EXCHANGE
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GUARANTEED "REBUILT" POWER EQUIPMENT

SQUIRREL CAGE MOTORS
3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1750	*G.E.	K	3600
1750	*G.E.	K	1800
1250	*Al.-Ch.	ANX	3600
600	West.	CS	720
600	*G.E.	K-63455	1200
500	*G.E.	K-63455	1200
500	*G.E.	I-13-E	900
350	*G.E.	KT-559-A	1800
300	*G.E.	K6344	1200
250	*W (TE)	CS-81295	1800
250	*G.E.	KT-599-S	1800
250	*West.	CS-875-S	1800
250	Brook	RS28	1200
200	*G.E.	FT-540	3600
200	West.	I-K-13B	1800
200	Brook	CSP-581-S	1800
200	*West.	RS-27	1200
200	G.E.	CS-930-A	900
200	*Al.-Ch.	KT-564-S	720
200	*West.	AN-37-G	720
200	Al.-Ch.	CS-1010	600
200	*G.E.	ARW-631	600
150	Cr-Wh	SC-140	3600

SQUIRREL CAGE MOTORS
3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
150	Al.-Ch.	AN 30-F	1200
150	West.	CSP-5815	1200
150	G.E.	I-K-15A	900
150	*West.	CS	600
125	Al.-Ch.	AR-226	1800
125	G.E.	5-Q	1200
125	Cr-Wh	K-558	900
100	W (TE)	CS-507-S	3600
100	G.E.	FT-542-Z	1800
100	Al.-Ch. (TE)	ARZ-826	1200
100	Al.-Ch.	AW-23D	1200

SLIP RING MOTORS
3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2500	*G.E.	MT (Mill Type)	257
1100	*G.E.	MT	720
1000	*G.E.	M-575-S	1200

SLIP RING MOTORS
3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1000	*West.	CW	450
600	*G.E.	M-6345-S	1800
500	G.E.	M-6345	1200
400	*G.E.	MTP-565	1200
350	*Al.-Ch.	ARYW	1800
300	Cr-Wh	SR70-R	1800
250	Al.-Ch.	ARY-626	1800
250	*G.E.	I-M-17A	720
200	G.E.	I-M-16	600
200	*West.	CW1950A	514
150	Cr-Wh	SR-50R	1800
150	G.E.	I-M-15A	600
125	G.E.	I-M-15A	600
100	G.E.	I-E-13A	1800
100	G.E.	MT558	720
100	G.E.	I-M-15A	425
75	West.	CW-770	1200
75	G.E.	MT-347	1200
75	G.E.	MT-356	900
75	G.E.	MT-352	720
75	G.E.	I-M-10	600
60	G.E.	MT-356	1200
60	*West.	CW-762C	900
50	*G.E.	MT-538	1200

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ALL TYPES OF EQUIPMENT IN STOCK

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Diesel Generator Units, 200 KW-1500 KW — Turbo Generators, 500 KW-10,000 KW
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DIESEL and GAS GENERATOR UNITS
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Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P. OUR 52nd YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
700	Whse.	Slipring	2300/4000	1200
600	Elliott (2)	Sq. Cage	2300	900
500	Allis Ch.	Slipring	2300/440	600
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse.	Sq. Cage	2300	900
400	G.E. (2)	Slipring	440	900
400	G.E.	Slipring	2300	514
400	El. Machy.	Synch.	440	400
350	G.E.	Sq. Cage	2200	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
300	El. Machy (2)	Synch.	2200/440	720
300	G.E.	Slipring	2200/440	600
300	G.E. (2)	Synch.	2200/440	360
300	Whse.	Slipring	2300	514
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Sq. Cage	2200	1800
250	Whse.	Sq. Cage	2300/440	600
225	G.E.	Synch.	220/440	900
200	G.E.	Slipring	440	600
200	L.A. TEFC	Sq. Cage	440	1200
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Whse.	Sq. Cage	2200/440	900
175	G.E. (2)	Synch.	220/440	720
150	Rel. TEFC	Sq. Cage	220/440	900
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E. 2)	Sq. Cage	2200/440	1800
150	Whse.	Slipring	220/440	1200
125	G.E. T.E.F.C.	Sq. Cage	2200	3600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
100	Whse. TEFC	Sq. Cage	220/440	900
100	Smith b.b. (6)	Sq. Cage	220/440	1800

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	RC	250	1450
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
125	Gen. Elec.	CD	250	1150
100	Reliance	651-T	600	1200
75	Gen. Elec.	CD-123	125/250	1200
60	Allis Ch. (3)	E-146	250	1500
60	Ideal	D	125	1150
25	Whse.	SK-103	250	1750

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
200	Whse. b.b.	SK	250	287/575
150	Whse.	SK-184	230	850
150	Whse.	SK-210	230	320/1000
125	G.E.	CD-173	230	575/1150
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Whse. (4)	SK-163	230	500/1500
60	G.E. TEFC b.b.	CD-135	230	1150
50	Century	DN-514	230	1150/1750
50	G.E.	CD-125	230	400/1200
50	G.E.	RP-16	230	250/1000
50	Reliance b.b.	310-T	230	600/1800
40	G.E. (2)	CD-93	230	1750
40	Whse. b.b. (2)	SK-163	230	300/1200
25	Whse. 2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
300	Whse. (2)	2200/440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	G.E.	220/440 AC	600 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
75	Star b.b.	220/440 AC	250 DC
75	G.E.	200/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC

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1—B & W "FF" Type Boiler, 310 HP, 160# Working Press. Built 1945, Water Tube, Complete with trim. Located: Ft. Lauderdale, Fla., Will ship, in 1 Piece.

2—Keeler "CP" Type Boilers, 250 HP, 160# Working press. Water tube, Complete with Trim.

2—B & W Vertical Sectional Header Boilers, 600 HP, 255# Working Press. 3 longitudinal Drums, 21 sections across. Each section 14—4" tubes high, 18 ft. long. Located Jersey City, N. J.

2—B & W Vertical Sectional Header Boilers, 400 HP, 200# Working Press. 2 longitudinal Drums 14 Sections across, Each section 14—4" tubes high, 18 ft. long (These 2 boilers have suspension steel enabling the 4 Drums to be hung from the same crossmember, and will make an ideal 4 Drum, 800 HP unit)

1—Westinghouse Turbine, non-condensing, 150 lbs. initial pressure, 12-15 lbs. back pressure, connected through reduction gears to either a 400 KW 3 phase 60 cycle 480 volt Generator with direct connected exciter; or can furnish and connect 1—675 KVA 500 KW 3 phase 60 cycle 2300 volt Generator. (the above equipment 1930)

42—B & W vertical header sections. Each header 14—4" x 18' 9 gauge tubes. These headers retubed in 1948.

SHERBE PLANT CONSTRUCTORS INC.
342 Madison Ave., New York 17, N. Y.
Murray Hill 2-9098

FOR SALE
14 NEW TURBINES

4 horizontal, 10 vertical, Westinghouse
Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired.
Price reasonable.

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

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Nation's Largest Warehouse Stocks

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CHICAGO 4 • HOUSTON 2 • LOS ANGELES 5

SPECIAL BARGAIN OFFERING

3500 HP, 360 RPM, 3 phase 60 cycle 2300/4000/4600 volts, General Electric Company 2-bearing, pedestal type, synchronous motor. Molern, practically new, guaranteed.

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609 National City East Sixth Building
Cleveland 14, Ohio

FOR SALE Complete Power Plant

Ready to go, consisting of 2 375 KW Westinghouse turbines one General Electric 1250 K W., 3 phase 60 cycle, 2300 volt 3 Stirling W. T. Boilers Coal Fired with stoker condenser, pumps, switchboard. Fraction of original cost.

ALBUQUERQUE & CERRILLOS COAL CO.
Madrid, New Mexico

BOILERS FOR SALE

1—90,000# 450 psi 700° 4 drum B & W Stirling
2—55,000# 600 psi 700° 4 drum B & W Stirling
2—Babcock & Wilcox sectional header 750 HP 200 psi

TURBO-GENERATORS WANTED

1—2500 KW 600 psi 700° F. Non-condensing
1—1500 KW 250 psi non-condensing

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Boiler & turbo-generator dismantling contractor

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Your requirements will be brought promptly to the attention of the used equipment dealers advertising in this issue. You will receive replies directly from them.

NO CHARGE
NO OBLIGATION

Searchlight Equipment Spotting Service
c/o POWER
Classified Advertising Div.
P.O. Box 12, N. Y. 36, N. Y.

Please help us locate the following used equipment:

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NAME.....

TITLE.....

COMPANY.....

CITY.....

STREET.....

ZONE ..... STATE.....

10/53

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3600
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2300/440	G.E.	720
150	220/440	Whse.	720
125	2300	G.E.	600

AC GENERATORS or SYN. MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300/440	G.E.	ATI	720
300	2300/400	G.E.	TS	720
300	2300/440	G.E.	TS	1200
200	2300/440	Whse.	G	1200
150	440/220	Whse.	G	1200
150	440/220	G.E.	TS	900
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2300/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
350	2300/440	G.E.	IE-K	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
200	440/220	G.E.	KT	1800
200	2300	G.E.	KT	1800
200	2200	Cont.	TEFC	3600
200	440/220	G.E.	KT	720
200	2200/440	G.E.	IE-K	1200
150	440	Whse.	X-prf.	3600
150	2200	Al. Chal.	KT	720
150	440/220	G.E.	TEFC	720
150	2200/440	G.E.	AR	1800
150	2300/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2200/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200
100	2300	Cont'l.	TEFC	3600
75(2)	440	Wagner	TEFC	1800

CIRCUIT BREAKERS, 3 Pole

1—6000 Amp., Whse., 600 V., Air, New
1—2000 Amp., R-Smith, 600 V., Air, New
4—1600 Amp., DA-50, Whse., 600 V., Air
6— 600 Amp., R. Smith, 7.5 KV, Sol. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	600
60/75	230	G.E.	CD	500/1500

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	440	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al. Ch., 2400/4160Y—600 volts, 3 ph.
3—333 kva, G.E., 13,800—2300 V.
3—333 kva, G.E., 2400-240/480 V.
3—250 kva, Al. Ch., 13,800—240/480 V.
1—200 kva, Al. Ch., 6900—230 V., 3 ph.
3—200 kva, Whse., 4600/2300—230/115 V.
1—200 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 13,800—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, Al. Ch., 440-220 V., dry New
3—150 kva, G.E., 13,200—2300 V.
3—100 kva, Whse., 4800/2400-240/480 V., Dry
3—100 kva, G.E., 2400—120/240 V., Pyr.

GASOLINE—ENGINE GENERATOR SETS

2—35 kva, 900 R, 220 V, 3 ph. conn. LeRoi, 6 cyl.
(1) 9.4 kva, 1200 rpm 120/240 V, 1 ph, Cont, 6 cyl.

only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

FOR SALE

512 HP HIGH PRESSURE BOILER

30,000 pound steam per hour Combustion Engineering boiler, type VU, two drum, bent tube, 450# steam pressure, 825° FTT, complete with spreader stoker and automatic control.

New 1950—Excellent Condition

INTERNATIONAL POWER MACHINERY COMPANY
1612 Union Commerce Building
Cleveland 14, Ohio MAin 1-9514

1500 HP D.C. MOTORS

1500 HP—525 volts D.C.—600 R.P.M.—NEW—2-bearing continuous duty motors—manufactured by Westinghouse. In original crates. From Navy Destroyer Escort. SPECIFICATIONS: 2-bearing 1500 HP—525 volts DC—2270 amps—600 RPM—ambient temperature 40C—class B insulation—2-bearing pedestal sleeve type—shunt wound—efficiency 94.23% ONLY 6 AVAILABLE—BUY NOW AND SAVE. Suitable for steel mill drive—offshore oil rigs—rolling mill drive—dredge pump applications.

THE BOSTON METALS CO.
313 E. Baltimore St. Baltimore 2, Md.
ELGIN 5-5050 LEXINGTON 9-1900

FOR SALE

1—2500KVA Westinghouse Turbo-Generator, Serial #1536P142—185 psi. 10,000 Lb. Ext. at 60 psi; 2300 V. Complete auxiliaries and switch gear.

1—G. E. Generator with Curtis 750 KW Steam Turbine—auxiliaries and switch gear. 2300 V—185 psi.

2—608 HP, B & W straight tube boilers with complete auxiliaries, 185 psi.

EVANS PRODUCTS COMPANY
COOS BAY, OREGON

COMPLETE NEW PLANT 4600 KW TURBO GENERATOR

GE Generator Type ATB-2, 3/93-1/3/2700 volts — 5600 RPM (Also 2950 KW 3/60/1700 volts @ 3600 RPM). GE Turbine 410 PSI @ 724°F, with 3800 sq. ft. surface condenser.

NEW MOTORS

1500 HP DC Westinghouse 525 Volts — 600 RPM 6000 HP AC G.E. 3/93-1/3/2700 Volts — 400 RPM reversible, (also 3800 HP @ 3/60/1700 volts — 257 RPM.) 460 KW GE Generator 3/93-1/3/2700 Volts (also 3/60/1700 Volts).

NEW FEED WATER HEATERS, Struthers & Wells, 206 sq. ft.

NEW DEAERATING HEATERS, Elliott 246,000#/hr, 1000 gal. capacity.

NEW CONDENSERS from 400 sq. ft. to 11,000 sq. ft.

POWER PLANT DISMANTLING SPECIALISTS
INSURED REMOVAL — ANYWHERE
HIGHEST PRICES FOR YOUR EQUIPMENT
HIGHEST PRICES FOR YOUR SCRAP

EASTERN SCRAP & SALVAGE CORPORATION
65 Muirhead Avenue
Trenton 7, New Jersey

BENJAMIN F.
SHAW
COMPANY
WAREHOUSE DIVISION

Available for immediate delivery: a wide selection of seamless alloy piping materials to ASTM-Spec. A-335:

99'	3"	Sch	80 — Gr P1
400'	4"	Sch	40 — Gr P1
200'	4"	Sch	80 — Gr P1
25'	6"	Sch	40 — Gr P1
180'	8"	Sch	40 — Gr P1
23'	8"	Sch	30 — Gr P1
422'	3"	Sch	160 — Gr P2
51'	4"	Sch	120 — Gr P2
110'	6"	Sch	40 — Gr P2
67'	8"	Sch	40 — Gr P2
22'	10"	Sch	100 — Gr P2
20'	16"	Sch	100 — Gr P2
68'	2½"	Sch	40 — Gr P5
140'	2½"	Sch	80 — Gr P5
87'	3"	Sch	40 — Gr P5
200'	3"	Sch	80 — Gr P5
200'	4"	Sch	40 — Gr P5
160'	4"	Sch	80 — Gr P5
33'	6"	Sch	40 — Gr P5
25'	6"	Dble Ex Hy	— Gr P5
17'	6"	Sch	160 — Gr P5
110'	8"	Sch	40 — Gr P5
113'	8"	Sch	80 — Gr P5
12'	8"	Sch	160 — Gr P5
187'	10"	Sch	60 — Gr P5
300'	2½"	Sch	80 — Gr P11
550'	3"	Sch	40 — Gr P11
460'	3"	Sch	80 — Gr P11
340'	3"	Sch	160 — Gr P11
85'	4"	Sch	40 — Gr P11
600'	4"	Sch	80 — Gr P11
120'	4"	Sch	160 — Gr P11
47'	4"	Dble Ex Hy	— Gr P11
23'	5"	Sch	160 — Gr P11
70'	6"	Sch	40 — Gr P11
440'	6"	Sch	80 — Gr P11
1800'	6"	Sch	160 — Gr P11
50'	6"	Dble Ex Hy	— Gr P11
300'	8"	Sch	40 — Gr P11
1070'	8"	Sch	80 — Gr P11
1348'	8"	Sch	160 — Gr P11
41'	8" x 1.264" Nom. Wall		— Gr P11
25'	8" x 1.25" Nom. Wall		— Gr P11
1080'	10"	Sch	60 — Gr P11
1076'	10"	Sch	80 — Gr P11
28'	10"	Sch	120 — Gr P11
43'	10"	Sch	160 — Gr P11
53'	10" x 1.563" Nom. Wall		— Gr P11
95'	12"	Sch	80 — Gr P11
95'	12"	Sch	100 — Gr P11
24'	12"	Sch	120 — Gr P11
324'	14"	Sch	80 — Gr P11
22'	14" x 1-13/16" Nom. Wall		— Gr P11
170'	16"	Sch	80 — Gr P11
33'	18"	Sch	100 — Gr P11
17'	24" x ¾" Nom. Wall		— Gr P11
68'	3"	Sch	160 — Gr P12
20'	5"	Sch	40 — Gr P12
180'	5"	Sch	160 — Gr P12
27'	6"	Sch	80 — Gr P12
31'	8"	Sch	100 — Gr P12
85'	8"	Sch	20 — Gr P12
22'	8"	Sch	40 — Gr P12
54'	10" x 7/16" Nom. Wall		— Gr P12
33'	24"	Sch	40 — Gr P12
225'	3"	Sch	80 — Gr P22
780'	4"	Sch	40 — Gr P22
86'	4"	Sch	80 — Gr P22
50'	6"	Sch	80 — Gr P22
46'	6" x 1.10" Nom. Wall		— Gr P22
330'	8"	Sch	80 — Gr P22
12'	8" x 1.212" Nom. Wall		— Gr P22

All items in stock subject to prior sale. Mill test reports furnished on request. For further information and prices . . . to place your order . . . contact

BENJAMIN F.
SHAW
COMPANY
Warehouse Division
2nd & Lombard Streets • Wilmington, Delaware
Telephone: OLympia 8-7181

Dependable piping fabrication and installation since 1893

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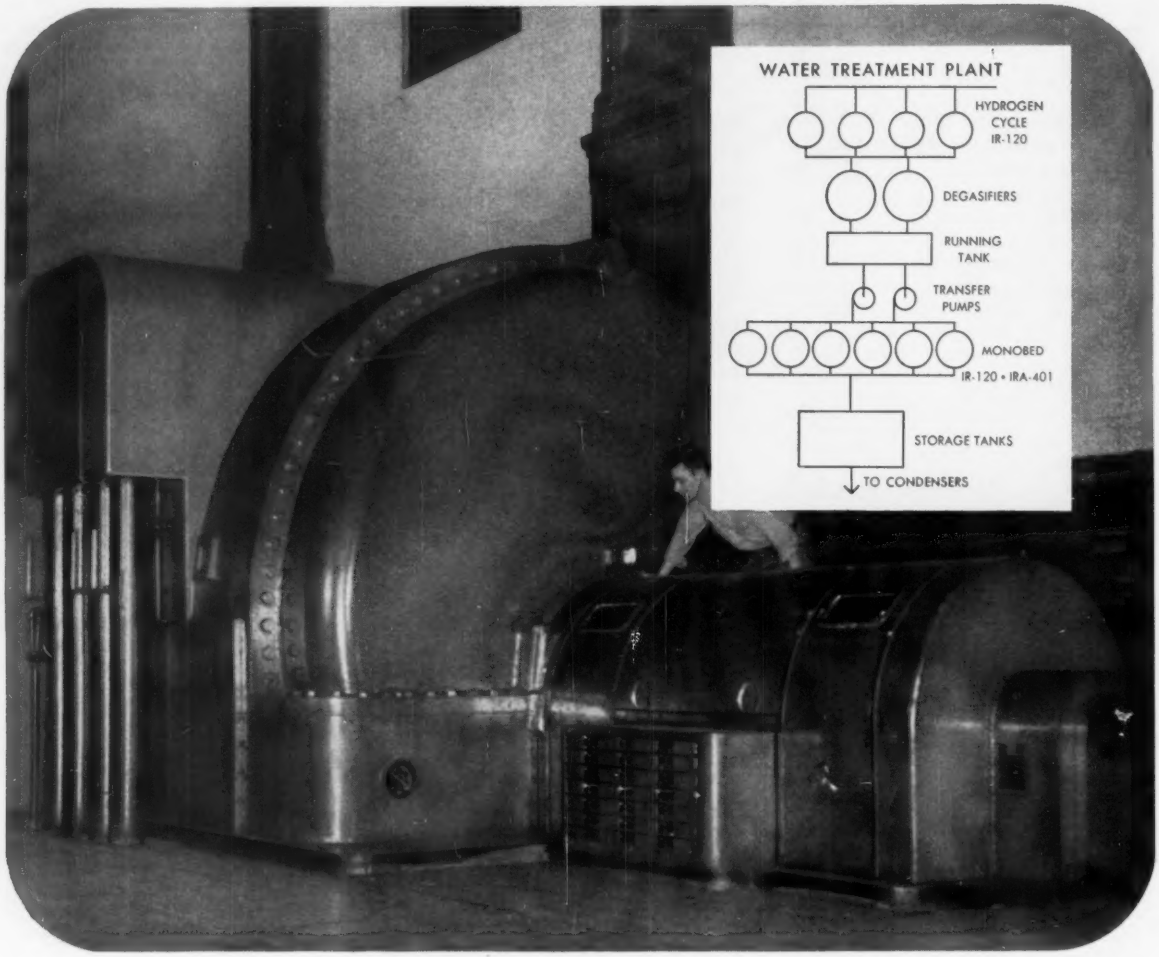
ION EXCHANGE RESINS for high pressure boiler feed



Make-up requirements run as high as 2,500,000 pounds per hour at this Consolidated Edison power plant, Waterside, New York.

"Over 45,000,000,000 pounds of low mineral and low silica content water produced—blow-down reduced—turbine blade fouling overcome"

This is the impressive record of the AMBERLITE ion exchange resin installed in 1954 at Consolidated Edison's Waterside station in New York. The water supply for this power generating station passes first through 4 beds of AMBERLITE IR-120 cation exchange resin operating in parallel in the hydrogen cycle, then through 6 MONOBED units in parallel (using one-third AMBERLITE IR-120 and two-thirds AMBERLITE IRA-401 anion exchanger) to provide a deionized water supply of extremely low mineral content. The MONOBED units have now gone through over 3,000 regeneration cycles.

This is but one of many AMBERLITE ion exchange resin installations which have given long and successful service. Naturally, the durability of ion exchange resins will depend upon the nature of the influent water supply and specific operating conditions.

If you use water, AMBERLITE ion exchange resins may provide an effective and economical solution to your problem. Your water conditioning engineering firm is qualified by experience to show you how AMBERLITE resins can serve you best. Write for our 24-page booklet, "If You Use Water" for full details on how AMBERLITE resins can soften, deionize, dealkalize or deacidify water.

AMBERLITE and MONOBED are trade-marks, Reg. U.S. Pat. Off. and in principal foreign countries.

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

For more facts circle 934 on Reader Service Card p 222

Main steam, boiler feed and miscellaneous piping for the nation's first full-scale commercial atomic power plant.

Dravo piping at Shippingport

Fabricating and installing piping for the Shippingport nuclear power plant presented many unusual problems. Specifications were extremely demanding and new techniques had to be employed.

In Dravo's Marietta shops, more than 3700 welds were made on stainless steel, aluminum, and carbon steel piping, ranging in size from 3″ to 12″ diameter. Many more thousands of welds were made at the site and all were thoroughly inspected and tested to assure performance under exacting conditions.

Each of the piping systems was hydrostatically tested at 1½ times the operating pressures. All of the butt welds and 99.9% of the more than 11,000 socket welds were leakproof on the first test.

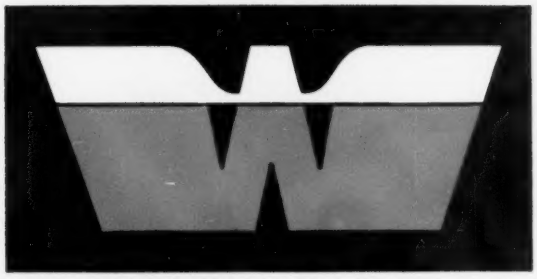
Fabricating and installing this piping for the nation's first full-scale commercial atomic power plant demonstrates Dravo's ability to handle piping projects of all types. A letter will bring full information on pipe fabrication and erection facilities—write Dravo Corporation, Pittsburgh 22, Pa.

View of the Shippingport Atomic Power Station which was built as a joint venture by the U. S. Atomic Energy Commission and the Duquesne Light Company. Westinghouse Electric Corporation developed the nuclear components of Shippingport under a contract with the AEC. Duquesne Light Company is operating the station. As a sub-contractor to Westinghouse, Dravo fabricated and installed more than 10 miles of piping at Shippingport.

DRAVO
CORPORATION

Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

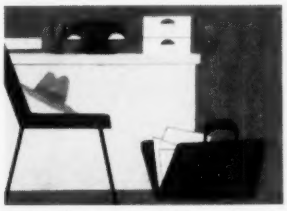
For more facts circle 777 on Reader Service Card p 222



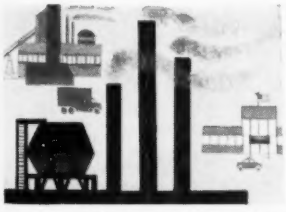
WORTHINGTON

This is our new corporate face... It is now in a newer form than our classic Worthington "wings", but it still represents to our customers, suppliers, and all who deal with us a most prized asset: our good name. We changed our trademark for this reason: it is superior in recognition values and qualities to our old mark. We change our products and designs for the same reason. We change for the better, as each day we learn more and adapt our new knowledge to our existing products and organization. This vigorous new "W" is as modern as Worthington itself. It is symbolic of our reputation for qualities which make Worthington and Worthington products outstanding in performance, reliable in operation, trusted in every market place in the world. We take pride in recognizing in our new face the strength of our experience and skills. It represents our good name.

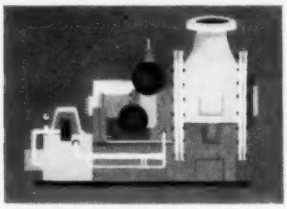
Worthington Corporation, Harrison, N. J. In Canada, Worthington, Ltd., Brantford, Ontario



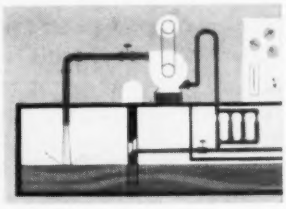
NEW sales organization...serves both direct and distributor sales, is geared to customer needs.



NEW decentralized divisions feature integral application, manufacturing and engineering units.



NEW product's and lines . . . include many additions to broad lines of power service equipment.



NEW emphasis on research . . . 10 laboratories keep Worthington in leading product-market position.